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TABLE OF CONTENTS

FEATURE ARTICLES

An Airy Chat with the Editor 12
Torpedo Bombers of the United States Navy 14
The Gamin Ace from Paris 17
Full-Page Insert—"Flying Fortresses" 19
Come Girls, Let Us Fly 21
The Radio-Meteorograph Broadcasts Its Readings 24
The Story of the Standards 26
How About an Air Detective? 27
Belgium's Multi-Place Fighter 29
The Airplane and the Law 32
Blind Landings Will Be Next 33
Flying by the Stars 34
". . . Clear and Unlimited" 35
Reserved Seats in the Air 37
The Allison Engine Passes Tests 39
How Not to Operate an Engine 40
Italy Breaks Another Air Record 41
So You Want to Be an Air Corps Pilot? 42
The National Air Board Says 47
Elements of Airplane Design 49
Parachute Jumpers Are Funny 51
Our Readers' Gas Models 53
How to Build the Howard DGA-8 Model 54

PICK OF THE BRIEFS

Swallow Aircraft's New Model C 16
Bomber Armada Nearing Completion 18
Do Airplanes Last? 20
Our Front Cover; the Morane-Saulnier 405.C1 22
Specifications of the World War Planes 30
Air Business Booms 30
Doings Up in the Stratosphere 30
Dragons Are Flying! 38
Fur Takes Wings 44
Pull 'Em Nose First 44
Just a Pilot's Get-together 44
Operating Cycle of the Junkers Diesel 44
Landing Gear Stresses 50
What One Woman Thinks 52

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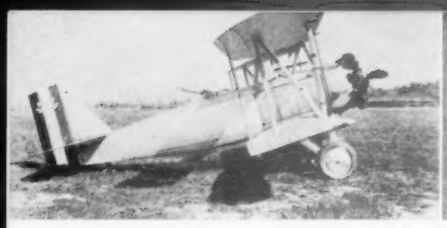
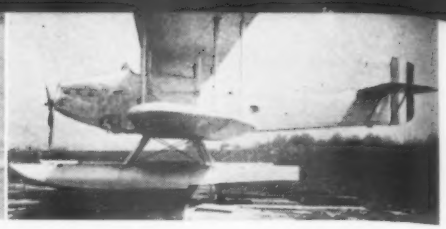




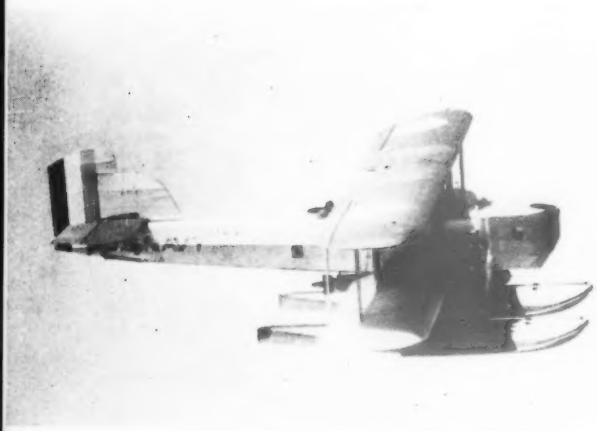
Only a few old-timers smelled the hot exhaust of these Navy aircraft. The ship at the left is one of the first of the famous line of Vought *Corsairs*. One of the Navy's earliest torpedo bombers was the trusty Curtiss CS-1 (center). Almost unknown was the Boeing TB-1 at the right.

Torpedo Bombers of the

by

GORDON SEAR WILLIAMS

Much of the submarine's potency may be replaced by the airplane in the next war. The torpedo plane has been developed by the U. S. Navy to the point where torpedo "bulls-eyes" now are commonplace.



Though Douglas Aircraft is best-known today for its internationally famed airliners, Douglas actually achieved aeronautical success in the early 1920's by turning out such successful Naval aircraft at the T2D-1 shown above (note the "tin fish" under the belly) and the Wright-engined DT-6 (below).

TORPEDO and bombing planes have long formed an important part of our Navy's air squadrons. They are the heaviest aircraft used aboard our carriers but, at the same time, are much smaller than the bombing planes used under that designation in the Army Air Corps.

The first torpedo planes of the Navy were in reality "triple purpose" ships, designed for the threefold duties of long range scouting, bombing and torpedo launching. Trials were made in the early 1920's of twin-engined ships of this type made by Curtiss, Fokker and Stout and showed good promise of being accepted for service use.

Strangely enough, however, the Navy Department did not order a single plane of any of these three types and instead branched off into the lighter single-engined category. These early twin-engined planes were all designed primarily as seaplanes, and it was probably the advent of the aircraft carrier, that used only landplanes, that precluded further development.

Perhaps the first actual torpedo-bomber was the old Curtiss R-6 biplane which used an eight-cylinder water-cooled engine. This type was later modified to incorporate the Liberty "12" engine of 400 h.p. and considerably better performance resulted.

In starting the history of Naval torpedo and bombing airplanes it would be well to mention that the Navy bomber or type "VB", is vastly different from the Army's aircraft of like name. Navy bombers are relatively small aircraft, usually only two place, and are designated as either horizontal or diving types.

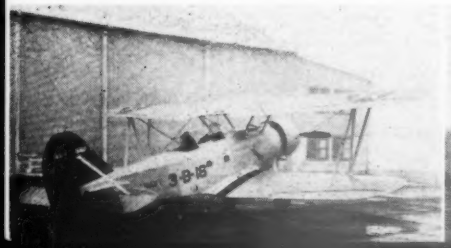
The dive-bombers are the most used type at present and are designed to release their missiles in a vertical or near vertical dive. They of course also carry machine guns, usually one firing forward through the prop and one flexibly mounted in the rear cockpit.

Dive-bombing was first tried as a fighting tactic by the Navy in 1927 when experiments were carried out with existing standard observation machines. Carrying 30 to 100 pound bombs they dived vertically for many thousands of feet before releasing their deadly load as they pulled out. This system proved to be so accurate that special dive-bombing types were immediately conceived.

The main attribute of the dive-bomber is the surprise element, as a ship of this type can usually dive and discharge its load of bombs before the ground crew can get into action. It was early recognized that to be effective the dive-bomber must be capable of carrying a greater bomb load than that of the modified observation types used in the first experiments.

Present day vertical bombers are more or less a compromise between the torpedo plane and the observation p'ane.

As Navy demands increased, manufacturers developed cleaner, sturdier designs such as the Great Lakes BG-1 (left), the new Northrop XBT-1 (center), and the converted Consolidated *Fleetster* (right). Of the three ships, just the Northrop remains, though still not accepted.



Glenn L. Martin entered the manufacturing scene early in the days of Naval aviation. One of his earliest types was the venerable T3M-1 (left and center). First of a long line of "three-purpose" planes for the Navy was the T4M-1 (right), veteran of many years' service.

United States Navy

Military aviation authorities, both Army and Navy, agree that one of the deadliest roles is that played by the dive-bomber. How this new phase of Naval aviation has been developed is shown here.

being larger than the observer but smaller than the torpedo plane.

A more recent type is seen in the combined torpedo-bomber, or type "VTB" ship. It is another example of the Navy's present day consolidation of types. It is destined to play an important role in Naval aviation as many are being built at present. Douglas is supplying the present service ships of this type, of the TBD-1 type. These huge low-wing monoplanes are not intended for dive bombing operations but function wholly as torpedo launchers and horizontal bombers.

In searching the records of the torpedo and bombing planes it will be found that Martin, Great Lakes and Douglas have supplied practically all service types for many years. In presenting the history of this very important branch of our Air Navy we will take them in the alphabetical order of the manufacturers so that the development of the various models can be more easily traced.

The Boeing Airplane Company has made but one type of torpedo plane, the TB-1, which appeared in 1926. It was similar to other torpedo planes of this time in most respects but featured side-by-side seating in the front cockpit for pilot and observer. A gunner was also accommodated in a single cockpit in the rear of the fuselage. It used a Packard 2A-2500 engine of 800 h.p., an engine much in favor at the time in use in practically all ships of this class up until the T4M Martin appeared in 1928.

Consolidated has made two experimental ships in this class, one a horizontal bomber and the second a dive type. The first ship, the XBY-1, was an adaption of the commercial *Fleetster* for carrier aviation. It had an all metal fuselage, wing and empennage, and used a Wright *Cyclone* for its power plant.

The cantilever metal wing housed gas tanks and floatation gear and was easily detachable from the fuselage. "Orange-peel" doors in the fuselage folded back to reveal the internal bomb racks. It proved rather large for carrier use however and was not adopted as a service type.

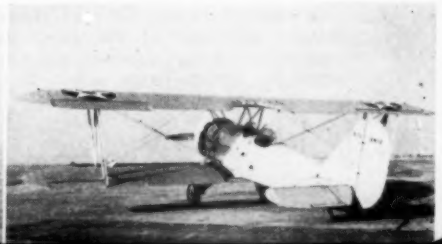
The second Consolidated bomber was of a greatly different type than the first, being a taper-winged biplane of the diving class. It was a development of Bureau design No. 110 and in most respects was much like the Great Lakes BG-1 which appeared at the same time. A *Twin Wasp Junior* engine of 700 h.p. was specified in the dive-bombers under Bureau design 110 and the fuselage was of metal monocoque type. The BG-1 proved to be a better type and was purchased instead of the B2Y-1.

Curtiss has made but few planes of the bomber or torpedo class, and all of these prior to 1925. These ships were mainly

(*Continued on page* 16)

For a time the U. S. Navy attempted to design and manufacture some of its own aircraft. But this competition with better-equipped airplane factories soon showed little promise. Two of these original Navy designs were turned over to Douglas (above) and Martin (below), respectively the T2D-1 and BM-1.

Up until only recently, Martin was extremely active in Naval work. His BM-1 (left) served long and well and was succeeded by the BM-2 (right) which helped make dive-bombing a major Naval aviation tactic. The Martin XT6M-1 (center) was the only ship of its type ever built.



of the CS-1 type, although the CT-1 twin-engined seaplane was used experimentally for a time.

Douglas has contributed much to the present knowledge at hand on torpedo and bombing planes. In past years they built many ships of the DT and T2D types. Donald W. Douglas, former Martin engineer, designed the early DT-2 torpedo plane in 1922. It was this plane that formed the first sizable order for the now world famous Douglas Aircraft Company.

This plane was a conventional two man crew biplane with a top speed of 99.5 m.p.h. It carried a regular 1,700 pound Naval torpedo slung between its floats and had a cruising range of 280 miles with full load.

A Liberty "12" engine was used. Later models, the DT-4 and DT-6, had boosted horsepower, using respectively the 600 horsepower Wright "T-2" and the 800 horsepower Packard 2A-2500. The DT-4 showed a top speed of 107 m.p.h. and a service ceiling of 6,050 feet.

Design changed greatly in the next few years and the Navy felt the need for a higher horsepower type with greater speed, range, and load facilities. The T2D-1 was designed to fulfil this need and was a twin engined, folding wing biplane powered with two Wright *Cyclone* engines.

First appearing in 1928, it showed a top speed of 125 m.p.h. and a service ceiling of 12,500 feet with a bomb load of over 1,700 pounds. Eight of these planes were delivered and could be used on either pontoons or wheels.

Douglas switched to single-engined airplanes in the T3D types, this time using a larger fuselage than that of the DT's and having but a single 830 h.p. *Twin Wasp* engine. Wheel pants and cockpit enclosures were still more of its features.

The various Great Lakes bombing and torpedo ships have served as standard service types in the Navy for many years, and even today many of the BG-1 dive bombers are in active use. The first torpedo model, TG-1, was basically the same as the Martin T4M-1, but had a simpler landing gear as well as a higher horsepower engine. Eight of these TG-1's were contracted for. A later type, the TG-2, used a geared *Cyclone* of 620 h.p.

Bombing planes built by this concern consisted of the BG-1 and XB2G-1 dive bombers. They are both of the same general type, the first having a fixed undercarriage and the latter type using a Grumman type retractable gear. Both use the *Twin Wasp Junior* engine of 700 horsepower and have tapered wings. Forty-four BG-1's were produced and are at present in use aboard our carriers by both Marine and Navy squadrons. The B2G-1 was not accepted as a service type, the present contract for this type ship going to Northrop.

A dual purpose XTBG-1 torpedo bomber was made by the Great Lakes company as a try at recent Navy contracts let for this type ship. It is a

(*Continued on page* 69)

Swallow Aircraft's New Model C

by M. R. CULLEN

Powered with a 125 h.p. Menasco engine, this ship sells for $3,990.

THE new Model C Swallow Coupe, developed by the late E. B. Christopher, now is being manufactured and marketed by the Swallow Airplane Company in Wichita, Kansas. Sam Bloomfield has been with the Swallow comdesign and develop the plane, and Opie Swope, test pilot and sales manager for the Swallow company, are the officials in charge of this work. Mr. Bloomfield has been with the Swallow company since Christopher took it over in 1933. He is a graduate in aeronautical engineering from the University of Frankenhausen in Germany and of the University of Berne, Switzerland.

The new Swallow is an ideal airplane for the sportsman pilot, private owner and operator. Its performance and economy have been achieved without sacrifice in strength, plus the comfort, visibility and convenience that have been made important features of the roomy cabin. Its clean lines, ease of flying, and minimum maintenance of both plane and engine also contribute to make it a desirable plane.

Powered with a 125 h.p. Menasco inline engine, the ship has a top speed of 145 m.p.h., a cruising speed of 135 m.p.h., and an operating economy of 18 miles to the gallon of gasoline. Parts are very easily replaced at reasonable cost—some of the bushings only costing 25 cents each. It is possible to repair the plane any place in the world as all the metal in it is chrome molybdenum. No aluminum alloys are used in its structure or control system.

The interior has been expressly designed to set a new standard of comfort in this type of ship. Wide doors for easy entrance—wide windows and a slanting "V" windshield for exceptional vision—wide full-fashioned seat for comfort and relaxation—complete appointments and an electric starter are standard equipment—and a big baggage compartment which is easily accessible in flight give the new Swallow distinction. Arrangement of the instrument installation has been worked out for the greatest efficiency, while the stabilizer, throttle, and hand brake levers are also grouped together for effortless control and operation.

The wings are constructed of solid spruce laminated spars with chrome molybdenum steel tube compression members, double drag trussing with tie rods. Ribs are of the truss type made of select spruce with plywood gussets.

The landing gear is full cantilever type tread 7½ ft., equipped with 6.50x 10 wheels with brakes. The shock absorbing mechanism is enclosed entirely within the belly of the ship, but is easily accessible for servicing.

The brake handle is located near the throttle and stabilizer for ease of control in landing and taxiing. When full on the brakes lock the rudder in neutral position. The brakes are differentially operated with rudder pedals.

The tail surfaces are constructed of chrome molybdenum steel tubing, fabric covered. The controls and hinges are constructed of chrome molybdenum steel. All moving parts are equipped with ball bearings.

Another model now being perfected by the Swallow company will be known as the C-160 and will sell for $5,390. It will be a three-place ship instead of the two seats in the "C".

Meanwhile, other details concerning the Model C follow: for the ship's normal range of 500 miles, 30 gallons of gasoline are provided for and, at cruising speed, the Menasco engine uses an average of seven gallons per hour. Stalling speed is unusually low for a ship this size: 43 m.p.h. Service ceiling is 18,000 ft.

Empty, the Swallow "C" weighs 1,350 lbs. while its gross weight is 1,980 lbs. Span is 36 ft. 8 in., length overall 24 ft. 4 in. and its height 7 ft. 3 in. At this writing, Bureau of Air Commerce officials had not yet assigned the "C" an Approved Type Certificate.

Deeply cushioned, adjustable seats make for comfort while the wide door is convenient. The large windows and slanting "V" triangular type windshield of safety glass give excellent visibility. The large baggage compartment is just aft of seat and accessible in flight. The price is $3,990.

The Gamin Ace From Paris

by CARL B. OGILVIE

Jean Navarre ignored and despised officers. He was ruthless and a dreaded killer. Germans and Allies alike whispered about him. Yet he made soldiers stop and stare in admiration.

A TWO-SEATER Voisin, marked with the tri-colors of the French Air Force, barked and wobbled off the Vaudelainecourt airdome, in 1915, during the heroic air defense of Verdun. It headed toward the snaky front lines on an artillery spotting reconnaissance.

Ahead of the clumsy French pusher the clear blue sky became clouded with balls of white Archie smoke. French anti-aircraft guns firing at an approaching enemy plane.

Soon, a sturdier, speedier Rumpler, proudly bearing the markings of the Imperial German Air Force, was muddering into position to pass the French plane on a parallel line. The Voisin accepted the challenge. As the two ships passed one another the observer of each hurled burst of polite lead. Each went on its way unharmed.

Suddenly, hurtling out of the blue above, came a red streak. Down it came with its motor roaring. Straight for the Rumpler it charged. The Rumpler observer tapped the Hun pilot on the shoulder. They regarded the tiny red Nieuport without fear. They laughed scornfully. What could a single-seater *chasse* pilot do to them but chase?

On plunged the Nieuport, dressing into position on the Rumpler's tail. Fool of a Frog! Didn't he realize the German observer would soon open fire and shoot him down for his foolhardy attempt to chase the Rumpler away?

Then, from above the revving propeller of the Nieuport red-orange fangs spat at the enemy aircraft. Incredible. Unbelieveable! The Nieuports were not equipped with machine guns. This Nieuport was so small that the recoil would tear away the knife-edged wing.

Before the Teutonic brain could grasp that they were flying at the cornerstone of French military aviation history 40 Lewis bullets had raked the tail assembly of the Rumpler, found the observer, then the pilot and sank its last dozen slugs into the gasoline tank and engine.

In Navarre's day, this Spad was considered the ultimate in fighting aircraft. Navarre, however, preferred the Nieuport with its lighter, faster control.

This was the first enemy airplane brought down by a French *chasse* plane mounting a Lewis gun on the center wing section. The pilot's name was Navarre. Spectacular Sous-Lieutenant Navarre of Chasse Escadrille 67.

This round-faced, pug-nosed pilot was the enigma of the French Air Service. He has been referred to as the father of pursuit fighting tactics, as the pilot supreme, also as an apache, street urchin, insolent, contemptible, an ungovernable insubordinate.

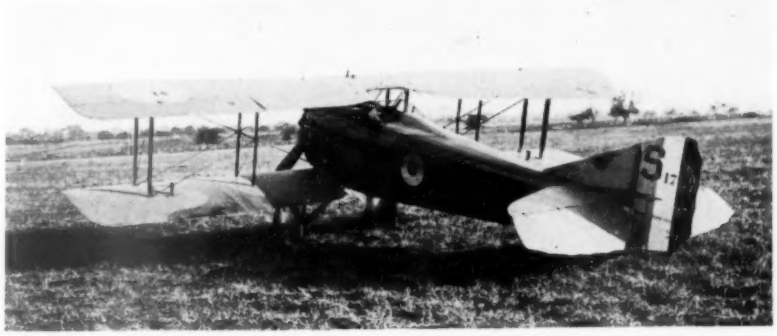
Born on the wrong bank of the Seine, he grew up in a squalid neighborhood. As a boy he learned the primitive law of survival of the fittest. He fought for what he wanted. Got only what he fought for. He recognized no law or authority. He was a law unto himself. At the Front he scoffed at military authority and orders of his superior officers. He came and went as he liked.

If he went to Paris he frequently ended up in a fight with gendarmes. If he took off over the Front he flew with more reckless daring than any other pilot of his Escadrille. His toying with enemy planes in the old *chasse* days proved him a born flyer. He liked to dart in and around them like a hawk, coming in so close the Hun pilots fled in terror of being victims of a collision.

The *petite* Nieuport, issued January 1, 1915, mounting a machine gun on its upper wing, gave Navarre his opportunity to win the title of "Pilot Supreme." The Baby Nieuport, powered with an 80 h.p. Gnome, was the first Allied airplane built mounting a machine gun. A Lewis gun was mounted on a tall tripod to permit the gun to be fired over the propeller tips. To fire the Lewis the pilot had to pull a string attached to the trigger. The gun, weighing 20 pounds, carried a single drum of 47 rounds. When the ammo supply became exhausted the pilot had to land to reload.

Navarre led the way in dealing death in the skies. A brilliant flyer became a spectacular fighter. The old *chasse* tactics were gone forever. He became the idol of the pilots and mechanics of the Escadrille, a pain-in-the-neck to his officers and to the civil police. Navarre could be found in one of three places: in his cubicle asleep, in the air ripping the E.A.'s to ribbons, or in the clutches of the gendarmes.

In the air or on the ground he created havoc wherever he choose to go. He knew no authority. Navarre was su-



While Jean Navarre preferred his "bebe Nieuport," most of his squadron mates gloried themselves in the cockpits of the heavier, more rugged Spads. This Spad was photographed as it stood on a French airdrome.

preme! He admitted it. Navarre did just as Navarre damned well pleased.

A high ranking general officer was due to inspect Navarre's squadron. The unconquerable French pilot preferred to work on his engine. The adjutant suggested he changed his coveralls for full dress uniform. Full dress had been ordered. The grease-smeared Navarre shrugged indifferently. "When the general sees Navarre, he sees a pilot of France, not a tailor's dummy!" he exploded.

The adjutant remonstrated. "But the general desires that you fly for him and display your great skill."

Navarre turned back to his engine. "Tell the general to parade his division for me. If he shows more comparative skill than I, then Navarre will fly for him. Bah! Does he think me a carnival clown?"

Such was the supreme egotism, the insolence of the untractable Navarre.

NAVARRE liked to taunt his enemies. He flew in a manner that "twisted the Boche." Above Le Morth-Homme near the famous Dead Man's Hill, Hill 304, Navarre twisted a two-seater Aviatik.

He sent his Nieuport twisting and writhing about like a snake one minute, then came darting in like a mad swallow attacking a hawk the next.

Not for a fraction of a second did he give the Boche observer an opportunity to open fire. Then gluing himself beneath the Aviatik's blind spot Navarre laughed uproariously at the ludicrous attempts of the Hun pilot to maneuver to bring his observer's guns upon the taunting Frenchman.

When tired of the frolic Navarre merely lifted the nose of his Nieuport and sent a well-directed burst into the belly of the Aviatik. With cold-blooded calculation the lead found the observer's body. The luckless Hun's body was thrown clear of the plane as the pilot rolled. Another burst and the enemy plane burst into flames.

When Roland Garros developed his apparatus for firing through the prop, Navarre dreamed of still greater achievements, of more victories. But Garros fell into the hands of the Germans and his invention was quickly improved by the Huns. Soon Navarre, winged defender of Verdun, found himself at an awkward disadvantage. He was fighting trim monoplane Fokkers with Spandaus mounted on the engine cowl.

Navarre fretted. The "Bebe Nieuport" had the edge on the Fokker for speed, but the Lewis gun on the upper wing reduced the air speed by at least seven miles an hour. Navarre decided that to keep pace with the Huns the French must develop a synchronized machine gun. He vowed he would get a Fokker so that the French could discover the Huns' synchronizing secret.

(*Concluded on page 60*)

Bomber Armada Nearing Completion

American air fans now are focusing their admiration on this mammoth Boeing B-17 Flying Fortress. Its tremendous size, power and range make even the most skeptical war-students gasp at its possibilities. But meanwhile, secretly in the background, closely guarded tests now are under way on . . .

"BOMBERS by Boeing" continue to hold the limelight in American military aviation circles. With the recent delivery of the eighth and ninth YB-17 (see opposite page) to the United States Army Air Corps, the original Air Corps order for 13 of these "Flying Fortresses" is almost completed. Crack bombardment pilots are rotating between eastern Air Corps bases and Boeing's Seattle plant to take delivery of the four-engined giants and ferry them back to their bases.

If these ferrying flights were not considered routine by Air Corps officers and if these ships were in the hands of publicity-anxious airlines, each flight of the "Flying Fortresses" would be heralded on the front pages of the world. When the third Fortress, for instance, was ferried from March Field, California, to Barksdale Field, Louisiana (1,500 miles), an average speed of 235 m.p.h. was recorded for the entire trip. Nevertheless, there was comparatively little publicity given this remarkable performance.

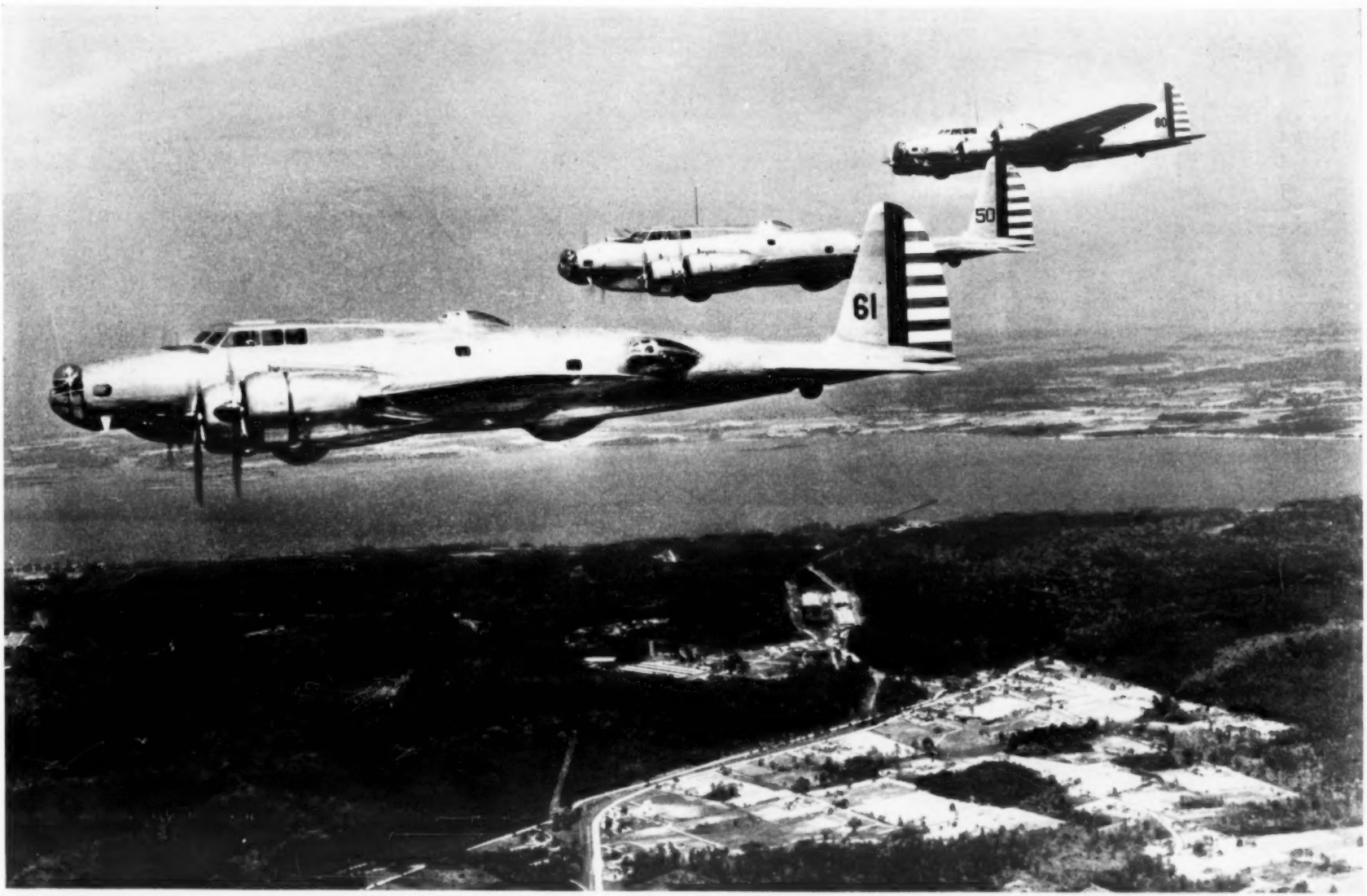
For an airplane that weighs 16 tons and carries a crew of six besides a tremendous load, the performance of the "Flying Fortress" is phenomenal. Though the original Air Corps specifications called for a maximum speed of from 200 to 250 m.p.h., the ships' performances on the ferrying flights point to a far greater performance achieved by Boeing engineers. Fully loaded, the YB-17's cruising range is said to be approximately 3,000 miles. If this is true—and it probably is, for the first plane of this type was flown non-stop from Seattle to Dayton, Ohio, (2,100 miles) in slightly more than nine hours—it would be possible for a fully loaded and armed ship of this type to take off from London, bomb Paris, Madrid, Berlin and return to London *without refueling or landing.*

But if the YB-17 is "phenomenal," consider the new XB-15, another Boeing. (Army Air Corps designate an aircraft design accepted for field tests with a "Y". Bombardment aircraft are designated "B". These letters are followed by the Air Corps serial number. The "X" means experimental. When the YB-17 passes field trials and is finally accepted, it will become merely B-17.)

Also a four-engine monoplane bomber, the XB-15 (the first was completed recently) boasts even greater performance and endurance than its "baby" brother. Under secret development at the Boeing plant for the past three years, the XB-15 is comparatively as complete an aircraft as a battleship is a seacraft. Living accommodations are provided aboard for the entire crew.

The XB-15 is so large it was necessary to install a complete 110-volt alternating current electrical system (the first ever used in aircraft). Two auxiliary gasoline engines drive the generator that manufactures the current. At this writing little more is known about this ship.

. . . this ultra-modern four-engined Boeing aerial battleship that has even the most up-to-date military aviation authorities guessing. It's known as the XB-15, is completely equipped with crew living accommodations besides an enormous capacity for a far more deadly cargo.



Official Photograph, U. S. Army Air Corps.

"Flying Fortresses"

One of the first formation flight pictures of the Boeing B-17's, Uncle Sam's potent four-engined bombers.

Four Choice Morsels for the Photo Fan

Japan is determined to capture a few world aviation records in the near future. The above ship was built at the Tokyo Gas Denki works and is said to have a cruising range of 9,000 miles.

This is a rear view of the Tokyo Gas Denki long range monoplane with which Japanese airmen soon will attempt to establish a new long distance non-stop speed record.

Trans-Atlantic mail carrying is said to be the primary mission intended for this new DeHavilland *Albatross*. Powered with four Gypsy 12 engines, this ship is being test-flown now.

These Focke-Wulf *Stosser* single-seater trainers are used extensively in Europe. Powered with a 240 h.p. Argus engine, this ship has a top speed of 170 m.p.h. and lands at 55 m.p.h.

Do Airplanes Last?

by
T-2003

SEVEN years is the average life of the passenger automobile.

The life of the well constructed airplane is more than seven years, but taking crashes, etc., into consideration, the average life of airplanes is about seven years.

At the end of this time, most airplanes will look and perform considerably better than automobiles, comparing their appearance and performance with the new article. However, the average airplane will have had more money spent on its maintenance and repair than the average car.

The Army Air Corps has some Curtiss *Falcons* in use which are about nine years old. Also some Boeing P-12s which are eight years of age. The latter type are interesting survivors of hard careers in their early age, when they were in the tactical pursuit squadrons and put through their paces during the tactical drills and maneuvers in these outfits.

Within the last few years most of them have been placed on a "semi-retired" status at schools or stations where there are no tactical pursuit squadrons but where pilots are stationed who must keep their hand in on the stick while they are going to service schools or working on temporary duties away from the squadrons.

Nevertheless, these old-timers (the airplanes) look "healthy"; and come up to the high mechanical standards set by the Army Air Corps.

The Navy has some Ford transports which are also flying satisfactorily, considering their age.

Just when should a plane be retired? Some private owners hold on to ships which can barely pass the inspector's tests, for sentimental or pecuniary reasons. But here is how the commercial companies and the armed services figure the thing out:—

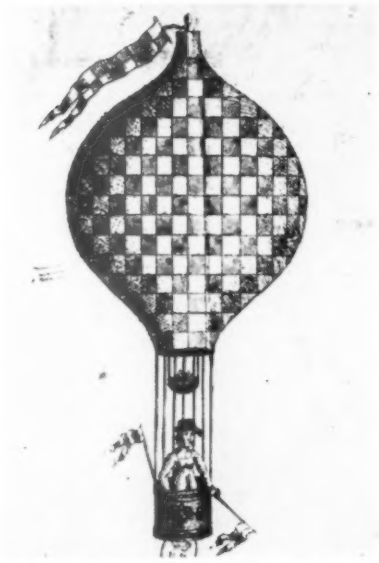
There is a certain minimum standard of safety and performance for a particular type of airplane. When such airplanes fall below this standard they are retired. Some however, are retired long before this stage; in cases where it costs too much to maintain them or repair them.

An airplane repaired or overhauled, one that is about six years old, is never as good as a new machine. It might cost $4,000 to overhaul a machine with the expectation that it will be good for two more years. But if a new machine, one of a later type with better performance, expected to last for eight or ten years, can be bought for $12,000 or so, then it doesn't pay to overhaul the old one.

The figures above are not exact but for purposes of illustration. It is better and safer to use two years of a *new* airplane than two years of an *old* one, even if the latter has been overhauled.

(*Continued on page 66*)

Aviation's first woman stowaway.



Madame Bittorf makes an exhibition flight

Madame Blauchard died in this manner.

Come Girls— Let Us Fly

by DR. OTTO BETTMANN

Montgolfier had nothing on a small but determined band of ladies who took to flying (it was "ballooning" in those days) 200 years ago. But many a pretty neck was broken.

WHEN we read in the papers about Amelia Earhart having a special flying laboratory built for her so that she can carry out researches in aviation, we swell with pride at the enlightenment of our day in which women have every opportunity equal to man.

Our smug reflections are rudely disturbed as we thumb through the pages of history and learn about famous women flyers of another day, yes, a day way back in the remote beginnings of aviation, when the hot-air balloon was the vehicle of the ethereal strata above.

These female pioneers of aviation besides risking their necks, and in some cases breaking them, with courage and elan, did so in costumes that would make ordinary promenading a hazard, to say nothing of the special perils besetting early flyers.

An ancient Abyssinian papyrus alleges that no less a personage than the famous Queen of Sheba was known to have dabbled with aviation. One of the gifts that old King Solomon gave the queen was a vessel for traversing the air (or winds) which his wisdom caused him to construct.

If one believes the part of the scriptures that maintains that there is "nothing new under the sun" and that "All things that will be already were, at an earlier time," it is easy to imagine the worthy Queen zooming down to the ancient equivalent of Addis Ababa, and her terrified subjects acting much the same as they did when Mussolini's air force paid its respects.

To pass from speculation to concrete facts, we skip through the pages of history and stop in the year 1784, one year after the first balloon flight was made by Pilâtre de Roziers and the Marquis d'Arland. Lunardi, a pioneer aviator was ballooning, as it was called, near Glasgow, when he made a landing in a rural district. A Mr. and Mrs. Chisholm approached the airman and showed a polite interest in his gear.

Mrs. Chisholm, unaccountable creatures these girls, expressed a desire to go "up in the air ever so high." While the two men were engaged in conversation regarding the boldness and insatiable desire for excitement, of the women of this accursed age, the lady settled the argument by scrambling into the ship and casting off.

Lunardi, like the gallant, quick thinking pilot that he was, leaped into the already moving vessel and conducted the flight. Mr. Chisholm gave vent to some choice remarks but they were unavailing. The first aerial stowaway of history had done her stuff. It is recorded that the three parties involved became fast friends but we can use our own judgment about that.

The first official flight of a woman occurred a year later in 1785, when Mrs. Sage ascended in a balloon with the same atmospheric Romeo. This flight

Even the horses shied in terror when Eliza Garnerin made the first parachute jump ever to be attempted by a woman. The date was August 25, 1815, and this old time print was made by an eye-witness. Oh, yes, Miss Garnerin's landing was successful.

was marred by a riot caused by irate farmers, the traditional enemies of the balloon, but some gallant lads from Harrow, who were fortunately near by, rescued balloon and passengers to the everlasting glory of the English public schools.

Marie Madeleine Sophia Blauchard was the first professional woman aeronaut. She made no less than 67 ascents some of them with her husband. She flew for a livelihood and died with her boots on, an early victim to the cause of aviation. Among her most notable flights was a special ascent she made in celebration of Napoleon's marriage to the Arch Duchess Louise of Austria.

For this commemorative flight she used an especially decorated balloon richly caparisoned and bearing the Napoleanic monogram. Great were the huzzas and plaudits of the crowd for our heroine.

Mme. Blauchard was a barn stormer and was known throughout Europe. As she travelled from place to place, her sensational exploits were eagerly witnessed by the populace. These travelled from surrounding cities and counted themselves fortunate, in the extreme, if they could catch a glimpse of our heroine. The excited witness of such a flight had story material for the rest of his life to relate to children and grandchildren.

Poor Madame Blauchard came to her untimely end when her balloon burst into flames on July 6th, 1819. She plunged to the earth amidst a comet-like streak of flame and ended her brave career.

Wilhelmine Reichardt made her first balloon ascent in Berlin in 1811. She was the first German woman to fly. She became a professional balloonist and made 45 flights. Mme. Reichardt was the cause of the oldest known police regulation regarding aviation. Because of her activities and because an old German folk motto reads, "German women do not fly," the zealous police, on Oct. 29, 1853, promulgated a ruling that women are forbidden to fly.

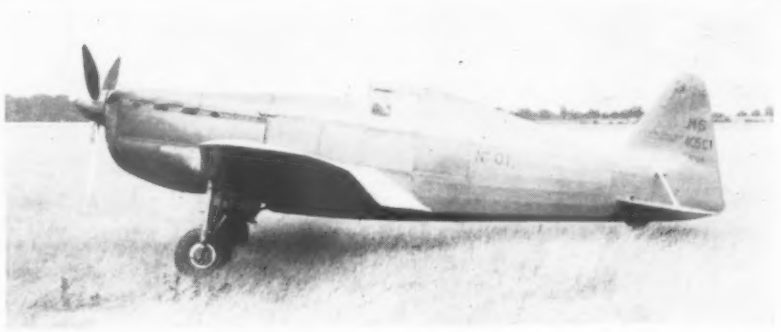
Other women of note at the dawn of aviation were Eliza Garnerin, wife of André Jacque Garnerin and Madame Bittorf whose husband was also a sky farer.

Flying held no fear for these women. They knew the devices to which they were trusting their lives were of the frailest and flimsiest construction. They knew that their knowledge of aeronautics and balloons was practically negligible. Yet, despite the obvious hazards and despite the efforts of governmental authorities to put a stop to their risky practices, these women flew—some with success, but many to their graves.

In connection with modern aviation a woman again played an important role. Catherine Wright, according to Wilbur, her brother, who made the first heavier-than-air flight, gave two-thirds of her salary so that her brothers could bring their experiments to a successful conclusion.

END

Our Front Cover; The Morane-Saulnier 405.C1



This new French pursuit ship boasts very clean lines and the powerful new Hispano-Suiza cannon-engine. The retractable radio transmitting and receiving antennae were not on this particular ship when this photograph was taken.

MACHINE guns aren't deadly enough these days. At least it would seem so, judging from a number of cannons that are becoming standard equipment on many military airplanes. With this advancement in mind, the Hispano-Suiza company developed its now-famous *Moteur-Canon* of approximately 800 h.p.

This engine is probably the outstanding feature of the new Morane-Saulnier 405.C1 cantilever low wing monoplane French fighter. Besides the cannon-engine, this new fighter carries two regulation machine guns and, in addition, is outfitted to accommodate one camera-gun.

Generally, the Morane-Saulnier is a conventional airplane. The fuselage and wings are of standard Morane-Saulnier construction. The landing gear is retractable as is the lower radio antenna mast which is used for radio reception. A stationary upper antenna mast serves for transmission.

The Hispano-Suiza cannon-engine has a 20 mm. quick-firing gun mounted on the top half of the crankcase in the Vee of the cylinders with the muzzle passing through the upper spur reduction gear pinion shaft and propeller hub. The gun itself is of Hispano-Suiza production and can be used to fire explosive, tracer, incendiary or armor-piercing shells. The speed of fire is practically the same as that of a normal synchronized machine gun. The weight of the cannon with its magazine of 60 shells is almost the same as two standard machine guns with their normal ammunition. The gun itself weighs 106 lbs., the 60 shells 55 lbs.

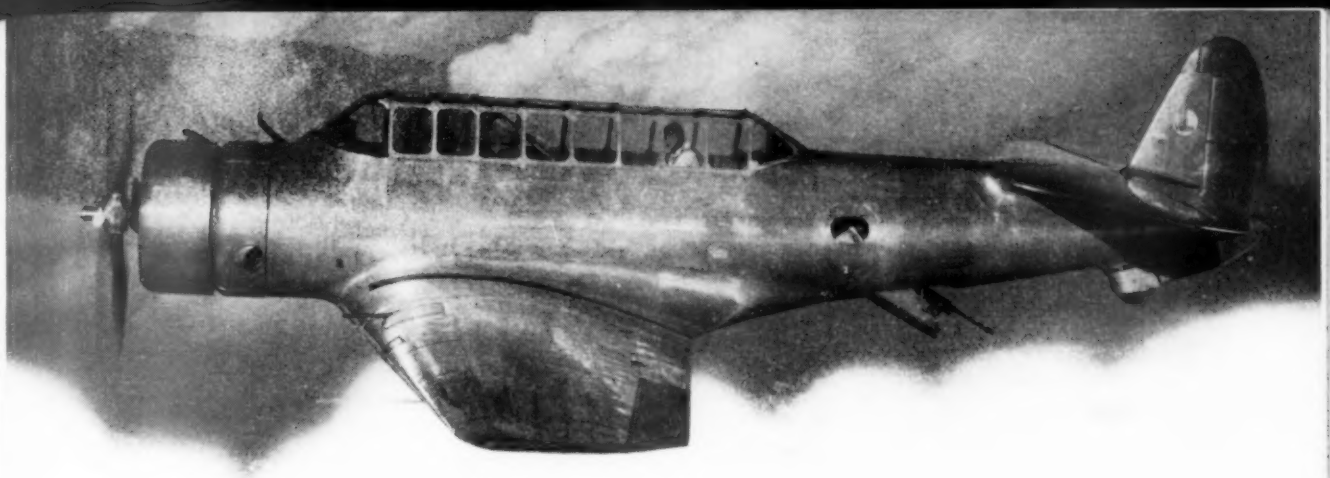
Only performance figure available for the 405.C1 at this writing show the ship as having a speed of 298 m.p.h. at 16,400 ft.

Duraluminum is used in this ship's construction throughout. The cantilever wing and the fuselage contain dural construction as does the tail assembly. Gas tanks are in the forward part of the fuselage and the radiator for the engine is beneath and slightly forward of these tanks.

The Morane-Saulnier's wing span is 35 ft. 10⅞ in. Length is 26 ft. 2⅞ in., while it stands 8 ft. 10¼ in. high. Wing area is 185.04 sq. ft. The landing gear tread is 10 ft. 4⅞ in. The ship's weight equipped but without its full load is 3,907.2 lbs. Fully loaded, the weight is 4,928 lbs.

This ship is one of the most radical departures in Morane-Saulnier history. Before, during and since the World War aircraft manufactured by this company have made French aeronautical history. Recently, the company has been devoting much of its efforts to the training and sport plane fields. However, with European rearmament in full swing, the firm has resumed its development of military aircraft, mainly single-seat fighters.

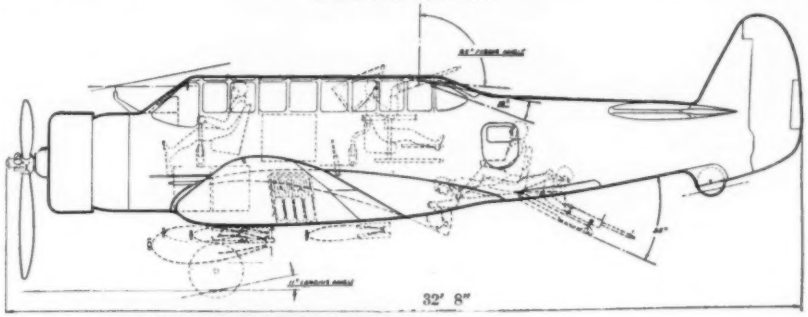
That hole in the center of the propeller hub is the business end of the 20 mm. quick-firing cannon that is built into the Morane-Saulnier's engine. Holes for the two machine guns can be seen in the wing just at the main landing gear struts.



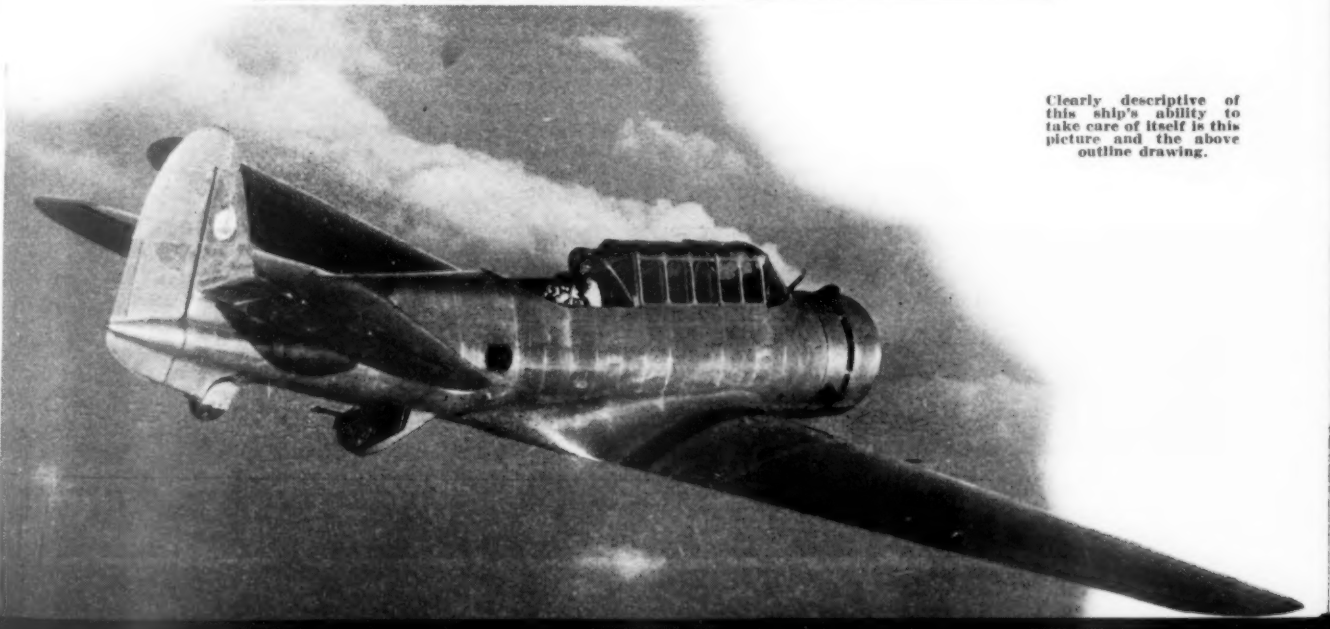
Vultee's Export Attack-Bomber

BIGGEST orders in Vultee Aircraft's California plant are for the deadly attack-bomber shown on this page. With the exception of China, Vultee's foreign purchasers have forbidden the American company to name its customers. When Department of Commerce aviation authorities banned single-engined transports on U. S. airlines, Vultee redesigned his V-1A (American Airlines, Bowen Airlines, Richman-Merrill) and went into production on the present military version. Four .30 caliber machine guns fire forward from the wing's leading edge, one from a flexible mount on the rear cockpit coaming, and one from the floor.

Vice-President Don P. Smith (left) and Gerard F. Vultee.



Twenty 30-lb. bombs also are provided for. Powered with a 775 h.p. Wright *Cyclone*, top speed is 226 m.p.h., service ceiling 24,000 ft, cruising range 1,500 miles. As a bomber, the speed is lowered slightly but the cruising range is upped to 2,700 miles. The ship is metal throughout with the exception of the ailerons and elevators which are fabric covered. There is a tripod bracing directly behind the pilot's head that is designed to carry six times the loaded weight of the entire airplane. The pilot controls the fixed guns, bomb releases and radio while the gunner is provided with an extra set of controls for use in case of an emergency.



Clearly descriptive of this ship's ability to take care of itself is this picture and the above outline drawing.

The Radio-Meteorograph

The sounding apparatus is ready for attachment to the inflated balloon.

The balloon transmitter unit consists of two '30 tubes connected in push-pull arrangement. Current 30 ma.

by S. R. WINTERS

THE Weather Bureau, acting in cooperation with the Bureau of Standards, hopes to establish new records in weather forecasting for aviation with the radio-meteorograph sounding balloon.

The radio-meteorograph is a tail-like apparatus carried by sounding balloons. This mechanism records meteorological conditions by means of a radio transmitter which broadcasts the instrument's readings to a radio recorder on land. The weather sounding balloon is unmanned and climbs to altitudes where the air is not sufficiently dense for human beings to supply their oxygen demands.

As the balloon rises and is carried through the clouds, an instantaneous automatic record of observations is made. The balloon is of tremendous significance to the Weather Bureau for it is capable of sailing well up into the stratosphere and the immediate atmospheric recordings when translated by the weather man can aid him in determining weather conditions several days in advance.

The radio-meteorograph apparatus, when connected with the balloon, weighs less than three pounds. Lightness of weight facilitates better ascension and likewise decreases the cost of production.

The balloons together with the instrument in its most recently perfected state will cost less than $10 apiece. At present the government is using radio-meteorographs which are made by experts at the Bureau of Standards, under the supervision of Dr. L. F. Curtiss. The balloons, which are bought from private concerns, have hitherto cost $20 apiece.

Recently, another concern reported that it is capable of manufacturing a balloon of better grade for as little as $2. The government expects to purchase a quantity of these balloons and thereby greatly reduce the cost of experimentation.

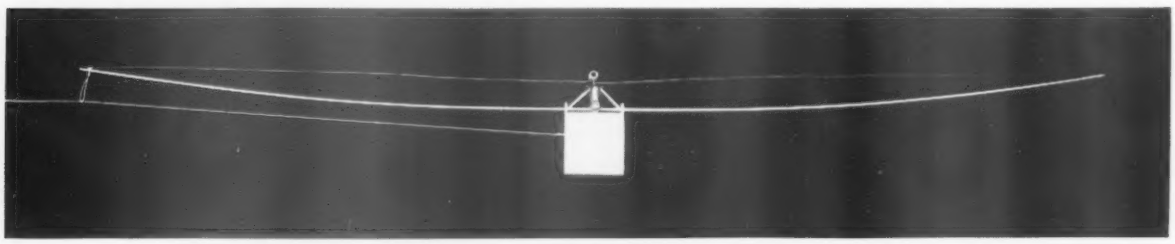
The radio-meteorograph helps the weather man by furnishing readings of pressure, humidity, and temperature at varying altitudes. A considerable number of radio-meteorographs have been constructed. These differ slightly in their special features. All of these instruments may be said to be composed of three elements: (1) a teleometeorograph, (2) a radio transmitter, and (3) a recording radio receiver.

The teleometeorograph contains a clock-like part with sweep hands, which are sensitive to the different elements of pressure, temperature, and humidity. The hands rotate in response to an electrical contact with the meteorological elements. The teleometeorograph is keyed to a radio transmitter and the same reading is sent electrically through the transmitter, whose special feature is a push-pull oscillator, to a recording receiver. This receiver is placed on the ground at a distance of two or three miles from the point of release in order that it may pick up signals from the teleometeorograph attached to the balloon even before release.

The radio recorders are simple radio mechanisms, inexpensive to operate and construct. They are tuned to the assigned wave-length so that they may be certain of good electrical contact with the meteorograph.

The receiver has a circuit which operates a tape-punching or ticker-tape mechanism that produces the record. The time intervals of the pulsing tick indicate the pressure and the temperature. The receiver can also determine how distance of two or three miles from the point of release in order that it may pick up signals from the teleometeorograph at-

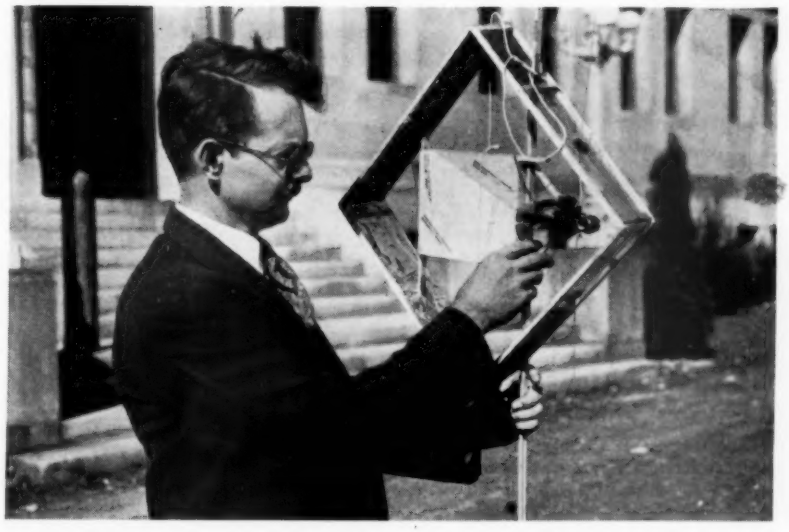
Dr. Curtiss has been doing extensive



And here we have the complete assembly of the transmitter together with the antenna and battery case which is suspended from the balloon. The cost of this exceedingly ingenious transmitter is estimated at $10.

Broadcasts Its Readings

METEOROLOGICAL research is advancing by leaps and bounds, particularly in the field of avigation. In this article, Mr. Winters describes a most interesting sounding balloon and recording mechanism being produced by the government in the interest of aviation—a recording instrument that transmits its findings by radio.



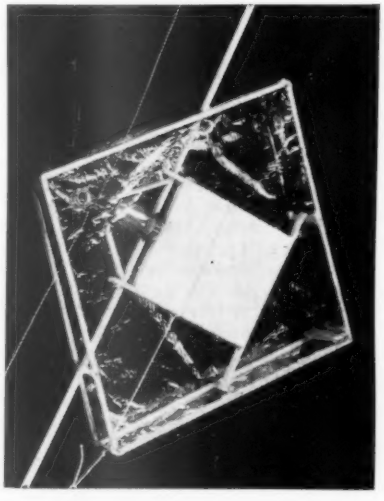
This is the clock assembled with the meteorological elements employed for "keying" the transmitter when it sends its messages to earth. This is an unusually compact instrument, light in weight, that possesses a considerable sending range.

experimentation with cellophane in Washington. He has been using a cellophane inclosure to shield the batteries, the oscillator, and the teleometeorograph as a means of protection from low temperatures. Cellophane balloons are expected to be of great importance in studies connected with cosmic ray observations.

The cellophane balloons used in the study of the cosmic ray are lighter and expand more easily. When sent up they are only partially inflated. This makes the balloon capable of flying at higher altitudes. Swarthmore College is carrying on similar observations of the cosmic ray.

At present, weather reports are furnished by piloted airplanes. There are about 25 airplane stations supplying this service throughout the country. The airplane records weather conditions on the aero-meteorograph. This type of weather recording has many disadvantages. Weather reports cannot be made while the plane is aloft.

It is only possible for an airplane to ascend as high as three miles into the air. The Army regulations forbid Army pilots to ascend higher because of the extreme danger of suffocation in mid-air from lack of fresh oxygen supply.



This is the cellophane enclosure used for the protection of the batteries and clock.

The maximum weather report that can be forecast by the aero-meteorograph is but two days in advance. Moreover, the cost to the government of a single airplane flight for the purpose of weather observation is $25.

It is not difficult to recognize the appreciable advance that will be made in weather reports when the radio-meteorograph is perfected. Less than a year back an unmanned sounding balloon equipped for radio-meteorography is reported to have reached an altitude of 26 miles in Soviet Russia, defeating the world's record of an altitude of a little more than 22 miles accredited to scientists in Hamburg, Germany, in 1930.

When the manless balloons are in regular use it will be possible for meteorologists to forecast atmospheric conditions for as many as five days in advance. This will be of tremendous advantage to aviation, agriculture and industry. There will be greater preparation for weather changes. There will be precautionary warnings as to the likelihood of storms, hurricanes and other hazardous conditions, so essential to safe flying. The sounding balloon can ascend well up into the stratosphere and make its reports from there.

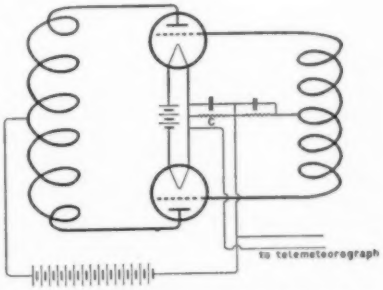
The stratosphere generally averages a distance above the earth level of from 6¼ miles to 8¾ miles, according to the season of the year. Observations can now easily be made from the balloon at an altitude of 12½ miles.

The higher the balloon rises after it has passed the substratosphere and has entered into the stratosphere, the more advanced in date will be the weather report.

Another decided advantage of the radio-meteorograph sounding balloon is the fact that it can make reports under icy conditions, and during electrical and snow-storms. There is no danger of loss of life or destruction of costly equipment as is the case with airplanes.

Additionally, balloons can be released from ships in mid-ocean and the radio-meteorograph can be used to predict perilous weather conditions at sea. Especially grateful will be owners and operators of small sailing vessels for reports of conditions at sea as such reports will be made available to them several days in advance.

With a sufficiency of stations spread about the country and with standard consistent flights of the sounding balloons, much information will be gained that will be to the advantage of not only the airlines but to farmers and bankers as well.



This is the circuit diagram of the transmitter showing the push-pull method of amplification.

The Story of the Standards

by ROBERT H. RANKIN

Ask any old-time pilot what he thought of the Standard. Many airmen reminisce over their fledgling days in aviation when the Standard and the Jenny were everything aviation had to offer.

TO THOSE who are familiar with the story of American aviation, the name Standard calls to mind the famous old J-1 primary training planes.

These ships, characterized by a square nosed fuselage and a slim radiator stuck up above the rear of the motor, were second only to the Curtiss Jenny and the Tommy-Morse Scout in popularity and up until as late as the year 1928 they were a common sight at many flying fields.

Although the J-1 is perhaps the best known of the Standards, it was the second in a series of more than fifteen models and types bearing the name of Standard.

The first Standard, the Model J, built by the Standard Aero Corporation in 1916, was a two place biplane with considerable overhang in the top wing. Powered with a 90 h.p. Hall-Scott A-7 motor and designed as a primary trainer this craft is interesting in that it was probably the first tractor plane on which the radiator was placed above the power plant. This same idea was also used on some German two-seaters during the War. The Model J passed Government tests and it was built for the Army in limited quantities.

Early in 1917 the Standard Aircraft Corporation was formed under the leadership of the officers of the Standard Aero Corporation and together the two organizations were known as the Standard Corporations.

The first craft produced by these two combined organizations was the J-1. As has been noted this is perhaps the best known of the several Standard planes. The J-1 was practically the same as the Model J except for the fact that it was powered with the 100 h.p. A-7-A Hall-Scott instead of with the 90 h.p. A-7 type.

There was no sweepback to the wings and a rather rugged cross-axle landing gear was provided. The tail surfaces were rather large and there was considerable gap between the wings. As usual in all designs of that period, the J-1 was fitted out with an abundance of interplane struts and bracing wires.

However, the J-1 was not equipped with wing skids which were so common to planes of that day. Built in quantity for the Army at a cost of more than $8,000 each, these ships rebuilt as clipped wing jobs and powered with 180 h.p. Hisso engines were still being sold ten years later for as much as $1,200 each.

Later the J-1 was developed into the JR. Very similar to the J-1 except for minor characteristics, the JR was used as an advance trainer. Then the H-3 was brought out.

The wings of this job were swept back slightly and for the first time in a Standard design the radiator was removed from over the engine. In the H-3 it was placed on the outside of the fuselage to the rear and right of the engine. The H-3 also differed from the earlier models in that it was an equal span job.

French equivalent to the Standard was this rugged old Nieuport-Delage biplane. In fact, this ship even resembles the old Standard somewhat.

The Standard concerns now went after Navy contracts with the production of several seaplane jobs. One of the most interesting of these was the Model D. This twin-engine machine also featured radiators over the power plants and it was mounted on large twin floats. No wing floats were included in this design, but an extra large pontoon was fitted under the twin-ruddered tail.

Another of the Standards built for the Navy was a primary training seaplane known as the JH. An unequal span biplane mounted on a single float, this craft differed but little from the other Standard models.

Following this, the H-4-H, an advanced training seaplane was brought out. Mounted on twin pontoons, there was considerable sweepback to the unequal span wings of this biplane. Although this ship featured no less than six sets of interplane struts, wire bracing was greatly reduced. A rather large radiator was stuck up over the center of the engine. For some reason or other in this and in the majority of other planes of this period almost half of the engine stuck up out of the fuselage into the air stream.

During the latter part of 1917 the Model E-1, "a defense advance trainer" was produced. Just what a "defense advance trainer" was is not clear, but from what can be learned from those who were with the old Standard concern it is apparent the ship was built for the advance training of pursuit pilots.

Showing plainly the influence of European design practices, the E-1 looked like a cross between a T. M. Scout and one of Tom Sopwith's later single-seater fighters. It was powered with a 9-cylinder Gnome rotary engine and it skidded along at something better than 106 m.p.h.

Mention should be made at this time of Standard DH-4 and the Standard-Caproni and Handley Page night bombers. It will be remembered that the Allied brass hats decided that these ships should be standardized for the Allied air services and that they should be built in quantity in this country.

The Standard corporations were called upon to build all the bombers and along with several other American manufacturers they were given an order for the DH's. As is well known the aviation industry in this country was in a muddle during the War and of the various foreign designed ships which this country attempted to build, the DH was the only one which was at all successful.

The Standard DH was up to the standard of the DH's built by the other American firms, but the bombers were a miserable failure. The reason for this was the fact that an attempt was made to build them about the then new Liberty motor instead of around the motors for which they were originally designed.

Standard was also called upon to build flying boats to the design of the reliable Curtiss HS-1-L and HS-2-L ships. The Standard-built HS-2-L, powered with a 12-cylinder 320 h.p. water-cooled engine proved to be particularly outstanding.

During the latter part of 1918 the JR-1-B, known as the Standard Postal

(*Continued on page 63*)

How About an Air Detective?

by ARCH WHITEHOUSE

One of America's most famed aviation fictioneers for the pulp magazines, Arch Whitehouse enters POPULAR AVIATION's fold with a bang-up piece on what may turn out to be a very smart idea.

THE other day I sat back and tried to compute the number of air thrillers I had written since a memorable day back in 1928 when I threw off the shackles of a newspaper job and went "free lance" as a pulp writer. I figured on an average of better than two a month . . . yes, nearer three, which would make the total to date about 350 which, on second thought, is still a pretty low guess.

Then I stopped and tried to think of one real basic fact for any of these stories. I tried to recall where I had ever actually read of an air holdup, a sky hi-jacking or even anything as mild as a mere murder in the cabin of a Douglas at 8,000 feet. I could recall none.

Where do we pulp writers get all our mad ideas?

Somewhat piqued, I went across the workshop to a battery of steel files where I plane each day's harvest of clippings taken from newspapers, magazines and trade journals from all over the world. In one folder marked "Hi-jacking" I found a clipping from an illustrated magazine in which someone had gone to a lot of trouble explaining how farm produce trucks were held up and relieved of their crates of parsnips, turnips and Swiss chard on lonely sections of road late at night; but not one clipping on the doings of aerial highwaymen, airmail bandits or sky-high mysteries.

I ransacked those files for more than an hour, but no sign of a clipping on an actual air crime and yet Gordon Harker, the noted British criminologist, recently stated that air-bandit stories will soon be routine news on the front pages of our papers. From what I can make out Mr. Harker has record of two bank bandits in Kentucky (of all places) who successfully rifled a safe and escaped by means of an airplane.

There have been mysteries in the air, of course, like the amazing disappearance of the Belgian banker Lowenstein from his palatial airliner while crossing the English Channel some years ago. A new U. S. Army fighter disappeared completely last year while being taken up for a secret test flight. Last December an airliner flying to the coast completely disappeared and only recently was found. There have been mysterious crashes but never any evidence of criminal acts or crime in the air.

Is it a wonder, then, that we air thriller writers who have always considered the airplane and more recently the dirigible, as something invented and built expressly for our basic points in adventure stories; discover with misgivings that the air and aviation in particular is the last field the crook appears to operate.

We discover that in spite of our lurid suggestions on the screen and in the pages of thriller magazines, Public Enemy No. 1 has never actually turned up in a transport plane, stuck his rod in the back of the pilot and demanded the registered mail. No crime syndicate has ever attempted to fool with the radio beam or the beacon guide-line to force a plane to crash and give up its cargo of negotiable securities or precious jewels. No madman has ever swiped a

Arch Whitehouse and one corner of the typewriter on which a mere few hundred aviation yarns—including this one—were banged out.

government fighter and hi-jacked the airliner carrying important documents from New York to Washington.

It all adds up to the fact that if we air-story writers hope to stay in business, something will have to be done about it. We might get up a Pulp Writers' Guild fund and get Mr. Harker to come over here and treat the Amalgamated Order of Air Line Archers to a series of pep talks.

The trouble with aviation, as far as the average criminal is concerned, is that it's too much for his poor distorted mind. For that matter, outside of the comparative handful of men actually engaged in aviation (there are only about 16,000 registered pilots in the whole of the United States), no one is really air-minded in this or any other country as yet. I am speaking now of the ordinary citizen who goes to work five days a week, takes in a movie now and then and wears out the Sabbath trying to figure out the Sunday comic supplements. You may know some one who once made a trip on an airliner. If so ask him what sort of plane it was, how many engines it had and whether it was a biplane or a monoplane. I'll bet you he can't answer any two of those questions.

The other night on the Professor Quiz program they nailed a man who had already answered about 95 percent of the sticky routine questions spat at him, by asking him what an aileron was. He gave up cold and went and sat down or whatever it is they do once they flunk out.

We all have been told that the average criminal is not intelligent, else he wouldn't be a criminal these days. An airplane is a mysterious dragon-like piece of mechanism that requires courage and patience to conquer. It demands discipline and certain professional skill. It is too much for the criminal mentality—as yet. He can drive a car, change a tire—or motor number—and even soup it up a bit with a can of ether, but his inherent cowardice combined with his sub-normal mentality, make the airplane something far beyond his ken or courage.

The crook might use an airliner in good hands, as a means of escape, but only in an emergency. It is a noticeable fact that whenever a much ballyhooed criminal is transferred from one part of the country to another by air, he usually puts up a squeal, begs off and demand transportation by rail.

The average criminal has no use for flying. He's afraid of anything he can't *force* to do his bidding. He can't digest the technical side of commercial flying. The beam system he has read about in a superficial way, probably reminds him of the scarlet charge that jolts its way through a man strapped in an electric chair. They wear belts, too, on take-offs and landings which probably adds to the illusion.

There's something clean about flying. Something straight. The average crook can't stomach that sort of cleanliness—the up-and-up cleanliness of the air.

But we must agree with Criminologist Harker. Once flying becomes more general, when we all have our own cabin jobs and are licensed for our levels; we shall see, or read about, crime in the air. We shall have our air bandits, our airliner hold-ups and aerial thuggery.

Once the crook learns to fly; once he really becomes air minded and feels at home in the air or in the cabin of an airliner, he'll begin to ply his trade aloft. He knows now that huge sums of money, negotiable paper and valuable express is accepted and carried every day over the air lines. He knows that there is little chance for the ordinary crook cracking

a crib 8,000 feet above sea level unless he gets into the flying game himself. His appoach may differ with every job just as it does on the ground, but he will have to know the air and his territory, so to speak.

One of these days we shall find ourselves in a welter of airmail holdups, sky hi-jacking and even pitched battles with the air police and air gangsters. It has to come. Somehow it seems to be in the scheme of things we call civilization. It had to come from the Dick Turpin days when the York-to-London coach was ordered to "Stand to and deliver!" It had to come with the advent of the automobile and mail trains. A few years ago the very thoughts of bandits armed with machine guns was almost beyond conception, but we got them plenty—right after the war. Today the idea of some crook purchasing a high speed private plane and secretly fitting it with synchronized machine guns is not beyond the realm of possibility.

But with the problem will come the answer: the air detective.

He will be a trim smart lad with a ton of imagination backed up with the finest technical training known to any profession. The field will be wide open, for there is no one in the world today who could even begin to set himself up in the business. If you don't believe me, look at the pathetic efforts produced by the best aeronautical minds in the world when they try to discover what caused the most ordinary crash.

Our air detective will find out—damned quick!

He'll be an expert on crashes and with a short efficient examination of a wreck he'll be able to tell instantly what caused the crash. He'll know why the upper longerons buckled and not the lower. He will know why only two of the propeller blades were broken off and not the third. He will know from the position of the variable-pitch propeller gear what was in the pilot's mind when the crash came. He will know at once whether it was an accident or . . . air banditry.

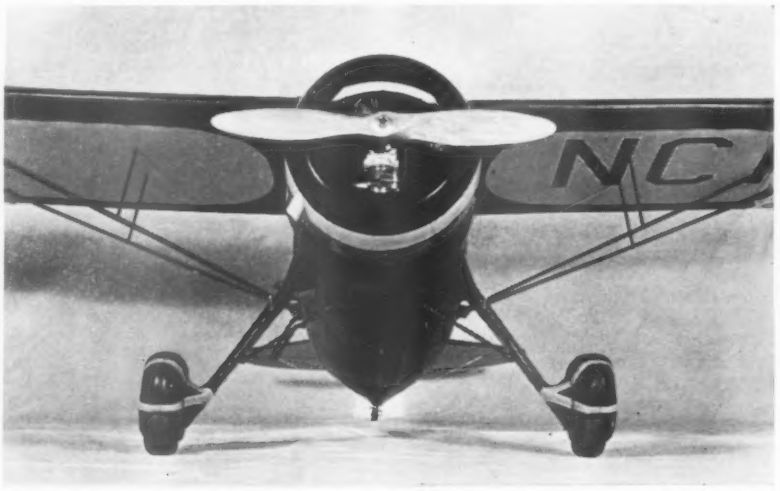
Fuels will come under his jurisdiction. Every brand will go into his test tube. He will find out if someone added a liquid or a chemical that changed the octane value of the gasoline at a critical period. If superchargers on high power engines blow up—and they often do—he will know what to look for. He'll find out if someone "fixed" one of the blades of the impeller and caused a spark that ignited the mixture being blown into the intake valves.

He will want to know why the airline pilot was using a day frequency at night. He will want to know why a pilot taking off from an airport reported a ceiling of 1,200 feet when there was only 600 feet of visibility. He will demand to know why a pilot was on the wrong leg of a beam signal out of Camden and he will show why a plane crashed 35 miles off its scheduled route.

There are answers to all these questions and the air detective will answer them.

(*Continued on page* 66)

What Ship Is This?



Your guess was probably wrong—at least ours was when we first saw the picture. It's not the big custom built airplane it appears. In fact, it's a head-on view of a gas model of Benny Howard's commercial monoplane that was built by Paul Lindberg, POPULAR AVIATION'S model editor.

AT first glance, this photo looks like a shot taken of a real airplane, but it's not. It is actually a front view of the gas model designed by Paul W. Lindberg, our model editor, and described in detail on page 54. Note the perfect proportions of the various elements of the ship, such as the landing gear members, external bracing and other feature points of the ship. The little "Cyclone" engine is just visible through the front opening in the cowl.

Let Us Weep With the Amateur

by PEYTON AUTRY

IT has been some time since the various and sundry governmental bodies began the oppression of the lowly amateur.

There have been amateur groups organized to lift this oppression, but it seems they only come and go with the inspirations of the would-be organizers. Some have struggled through a meager existence which is far too weak to fight federal and state regulations.

Can it be that these organizations have been failures because the wrong plan of attack was taken? Let us try to analyze the situation in an effort to devise some plan of action which would be more or less sure-fire once such an organization has been formed.

First, the thing which seems to have caused the entire situation is the regulation of unlicensed aircraft by the federal and state governments. The various state governments have undoubtedly caused the amateur more worry than any other one thing.

It may be possible for a good organization to gain enough power to expel these laws within their own state, but to take up the troubles of fellow amateurs in other states is pretty near impossible. Therefore it may be that too much time and effort can be expended in fighting state regulation.

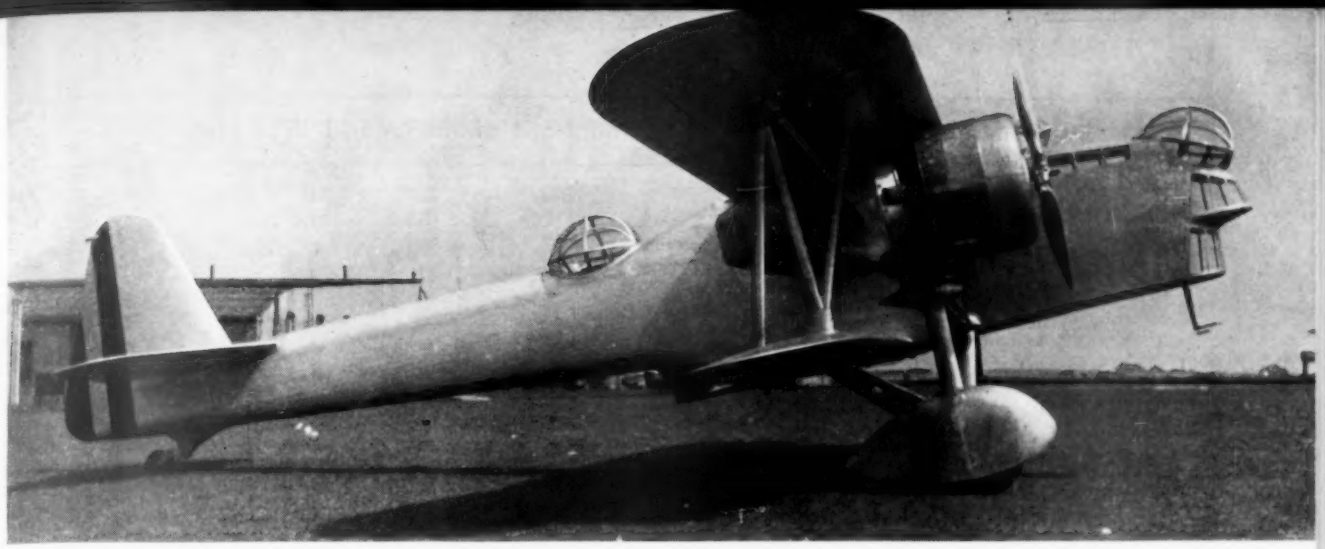
It is then for us to turn to federal sources in an effort to derive something which might be beneficial to the amateur cause. It is plainly foolish and a waste of time, energy and money to fight such a body as the Department of Commerce. Why then, cannot we attempt to cooperate with the Department instead of complicating matters?

It is a well known fact that for the amateur it is both difficult and expensive to construct a home built plane which will meet the requirements for a Department of Commerce approval. The entire difficulty herein is the amount and nature of engineering data required for submitting to the Department.

Would it not be better to take the funds of an amateur organization and apply it to the furnishing of members with approved plans of some lightplane instead of *giving* said money to some scheming politician who vows to break amateur regulation? For the construction of a home-built aircraft from approved drawings, the Department of Commerce requires that complete technical data be submitted (drawings and stress analysis).

Much the same procedure is taken as in the obtaining of an Approved Type Certificate for a plane which is to be manufactured and put upon the market. Also the designer must build or have built at least one complete airplane in accordance with the drawings for which approval is desired. This plane is to be inspected by the Department for work-

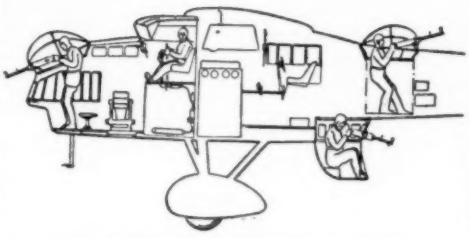
(*Continued on page* 61)



Belgium's Multi-Place Fighter

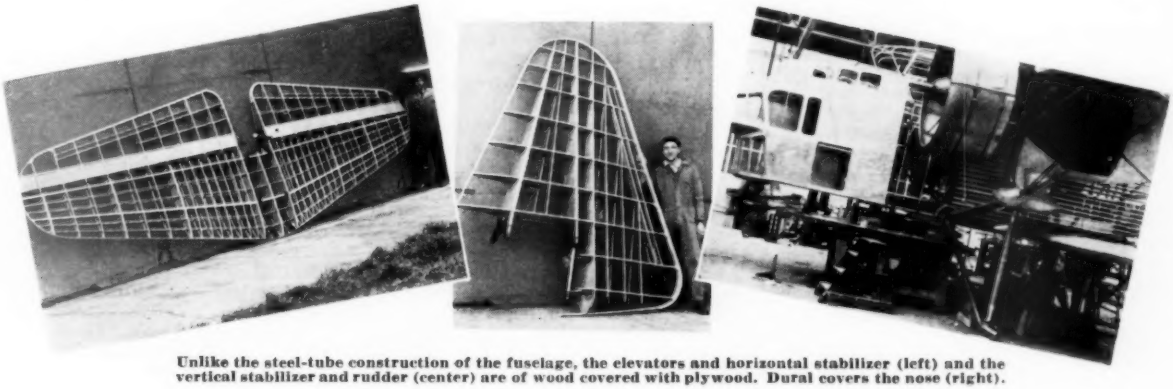
FEW persons have ever seen or heard of a fighting airplane larger than a two-place pursuit ship. POPULAR AVIATION, however, recently obtained pictures of one of the rarest military airplanes anywhere in the world today—a four-place fighter.

This twin-engined (two 780 h.p. Gnome-Rhone's) L. A. C. A. B. fighter was developed and tested recently for the Belgian government. Its main purpose is to replace the conventional single- or two-place pursuit ships by substituting four flexible machine guns with one man to operate each. In addition there are accommodations for a vertical camera while the top rear machine gun can be replaced with a light rapid-fire cannon. Intercommunication telephone connects the pilot with all gun positions.

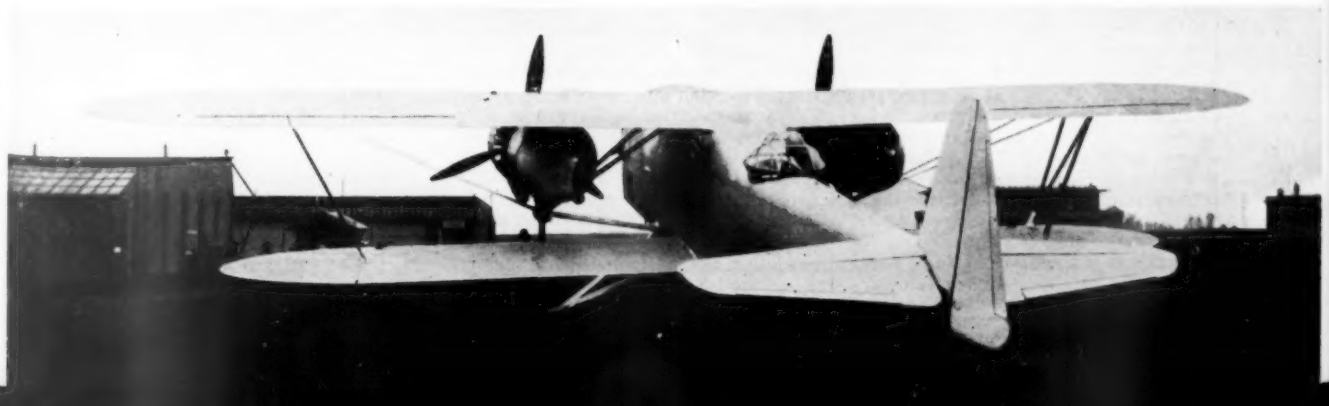


Note the extra set of controls for another crew member in case the pilot is injured during an aerial battle.

With a cruising range of 620 miles, the L. A. C. A. B. fighter has a top speed at 13,120 ft. of 223.5 m.p.h. The ship's landing speed is 59 m.p.h. while its ceiling is 27,880 ft. Span of the upper wing is 59 ft., while the span of the lower wing is 46 ft. 10 in. Length is 44 ft. 1 in., height is 13 ft. 7 in. and the wing area is 699 sq. ft. Empty, the L. A. C. A. B. weighs 7,480 lbs., loaded weight is 11,440 lbs.



Unlike the steel-tube construction of the fuselage, the elevators and horizontal stabilizer (left) and the vertical stabilizer and rudder (center) are of wood covered with plywood. Dural covers the nose (right).



Air Business Booms

AIRPLANES (3,010; nearly double 1935's total) and parts manufactured during 1936 in the United States had a total value of $47,531,565, it has been announced by the Bureau of Air Commerce. Meanwhile, the entire American civil aeronautics industry produced aircraft, engines, equipment and spare parts valued at $78,148,893 during the year.

Other interesting 1936 data also released by the Air Commerce Bureau shows a total of 30,575 persons employed by aeronautical manufacturers. A total of 4,295 engines were produced during the year which (with spare parts) were valued at $26,383,055. Propellers, parachutes and pontoons worth a total of $4,234,273 also were produced during 1936.

These totals cover all aeronautical production in this country, including aircraft and equipment for civilian use, for military deliveries and for exporting to purchasers in foreign countries.

Midnight Rainbows

WHILE flying in the vicinity of Custer, Montana, early one morning recently, Northwest Airlines Pilot Carl F. Leuthi and his six passengers witnessed a rare phenomenon—a rainbow by moonlight. At the time, the eastbound Lockheed airliner was passing through the edge of a slight shower at 9,000 feet. A full moon shone above the clouds. Suddenly, according to Pilot Leuthi, the full spectrum of the rainbow appeared to the north of the plane's route. The various colors were easily distinguishable.

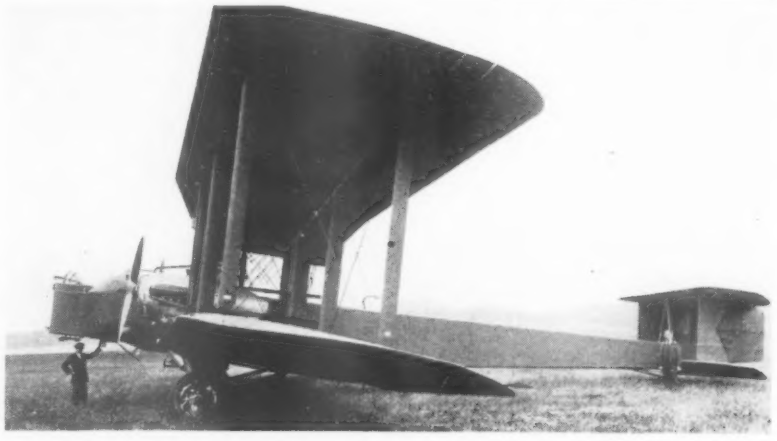
Meteorologists say this is the first time such a sight has been reported and that it is indeed a rarity. However, many other "phenomenal" sights have been seen while flying the airlines. Most talked-of of the more common sights are the "series" of sunsets passengers flying in the mountains can see almost daily. Some passengers and pilots have reported witnessing as many as four sunsets on the same day. What actually takes place is the setting of the sun behind mountain peaks of various heights.

Benny Howard, Engineer

COMPLETELY recovered from his recent crash in New Mexico during a transcontinental flight with Mrs. Howard in "Mister Mulligan," Ben O. Howard has returned to work at United Airlines as that airline's flight research engineer in the technical division of that company.

Benny is pilot as well as flight engineer of United's twin-engined Boeing "flying laboratory" in which new equipment and devices are being tested for possible future adoption by that airline. Biggest current job for Benny and the line's other staff engineers is the development of anti-static radio equipment and the perfection of a blind-landing radio beam.

Specifications of the World War Planes



Here's the old Vickers Virginia with its biplane tail—a monster of her day.

WORLD War airplane "fans" have written so many letters to POPULAR AVIATION requesting specifications of various types of war planes that we finally have secured a complete tabulation of these planes.

Practically anyone who even remembers the war is familiar with such famous names as Spad, S.E.5, Sopwith, Bristol, DeHavilland, Salmson, Handley-Page, Caproni and a dozen other types of lesser fame.

So here for the first time, POPULAR AVIATION presents a complete table concerning the most famous of these machines, complete to dimensions, performance and mission. In addition there's some invaluable dope about the engines that hauled those ships into aerial battles.

Doings Up in the Stratosphere

UTILIZATION of both stratosphere and substratosphere for commercial flying promises imminent reality, in alliance with the emphatic trend of aviation interests during recent months toward high altitude transportation.

Stratosphere flight offers numerous distinct advantages, among them being augmented speed which is possible of attainment along with even more important avoidance of storms and subsequent elimination of schedule delays owing to fog, ice or other inclement weather conditions.

Already the experienced transport pilot frequently avails himself of favorable circumstances found only in the upper air and it is not an uncommon practice for him to send his plane upward 10,000 to 15,000 feet in an endeavor to surmount varied obstacles of adverse winds and other disturbances, or probably more often, the ever-familiar "rough" air nearer ground.

Present pedictions indicate that within the next five years transcontinental aircraft will span the country at greatly increased elevation and speed and air-mail planes will literally "climb the sky" at new heights.

It is entirely possible that eventually flying in the upper strata may afford a fertile field of experimentation for sportsmen pilots, private plane owners and other non-professionals, a situation analogous to the early days of radio when amateurs developed the short-wave era of radio communication.

Strato-planes to fly in the substratosphere are being planned not only in the United States but in Germany and France as well. In our own country, two factories have designed models for multi-motored, super-speed transports capable of ascending 40,000 feet, at which point the theoretical line of stratosphere proper begins.

Principal difficulties in strato-plane design have involved greatly increased cost of construction, together with development of engine superchargers to function efficiently at various altitudes, particularly above the 30,000-foot mark.

The important work of a supercharger is accomplished by compression of the rarified air to an equivalent mixture at lower levels which prevents loss of power as the plane ascends. Arrangement of sealed cabins and cockpits, providing sea-level atmosphere supplied by pressure to occupants of the plane is also an essential feature and has constituted a major problem.

High altitude flying has been aided largely through the pioneering experience of Army and Navy experts and stratosphere balloon fliers alike. Seemingly hypothetical or purely scientific in purpose, a majority of these flights have presented an array of facts later crystal-

(*Concluded on page 73*)

PURSUIT PLANES

PLANES	FRENCH		BRITISH					ITALIAN		
	SPAD 13C1	SPAD 7C1	SOPWITH DOLPHIN	SOPWITH SNIPE	S.E.5 A	BRISTOL FIGHTER-F2B	SOPWITH CAMEL	S.V.	POMILIO	ANSALDO I
MONOPLANE - BIPLANE - TRIPLANE	B	B	B	B	B	B	B	B	B	B
PUSHER - TRACTOR	T	T	T	T	T	T	T	T	T	T
WING SPREAD (FT.-IN.)	26-3	27-4	32-6	30-0	26-7	39-3	28-0	15-3	28-7	25-2
OVERALL LENGTH (FT.-IN.)	20-8	19-3	24-3	19-0	19-6	25-10	18-9	12-2	19-0	19-3
NO. OF MEN IN CREW	1	1	1	1	1	2	1	1	1	1
NO. OF FIXED GUNS	2	2	2	2	2	2	2	2	2	2
NO. OF FLEXIBLE GUNS	0	0	0	0	0	1	0	0	0	0
SPEED AT 6,500 FT.	135	132	131	128	128	108	108	142	137	134
TIME REQD. TO CLIMB 6,500 FT.	4-40	4-40	7-0	5-0	6-36	8-6	6-42	4-15	4-30	5-30
CEILING (FT.)	22,300	21,300	20,000	19,500	19,000	17,000	18,500	26,200	26,200	26,200
ENDURANCE (HRS.-MIN.)	1-40	1-30	2-15	2-15	3-0	4-0	2-30	3-0	1-40	1-40
— ENGINES —										
NO. USED	1	1	1	1	1	1	1	1	1	1
NAME	HISPANO SUIZA	HISPANO SUIZA	HISPANO SUIZA	B.R.2	HISPANO SUIZA	SUNBEAM	CLERGET	ISOTTA FRASCHINI	FIAT A12	SPA.
ROTARY-RADIAL-VERTICAL-VEE	VEE	VEE	VEE	VEE	VEE	VEE	ROTARY	VERT.	VERT.	VERT.
NO. OF CYLINDERS	8	8	8	8	8	8	7	6	6	6
TOTAL H.P.	235	205	200	200	180	200	130	260	260	220

OBSERVATION PLANES

PLANES	AMER.	FRENCH				BRITISH				ITALIAN		
	D.H. 4	SALMSON 2A2	CAUDRON 11A3	BREGUET 14A2	SPAD 16A2	D.H. 4	D.H. 9	R.E.8	BRISTOL FIGHTER-12B	POMILIO E.	S.I.A. 7B2	S.A.M.L.
MONOPLANE - BIPLANE - TRIPLANE	B	B	B	B	B	B	B	B	B	B	B	B
PUSHER - TRACTOR	T	T	T	T	T	T	T	T	T	T	T	T
WING SPREAD (FT.-IN.)	42-5 3/8	38-6	38-9	43-11	36-9	42-4	42-5	42-7	39-3	39-0	43-8	39-8
OVERALL LENGTH (FT.-IN.)	29-7	27-11	36-9	29-2	25-5	30-2	30-2	27-10	25-10	29-4	29-9	27-11
OVERALL HEIGHT	10-1	9-6	9-2	10-9	8-6	10-2	9-8	11-4	9-4	10-2	10-4	9-9
WING SURFACE (SQ. FT.)	439	398	583	527	322	436	437	378	408	495	517	420
TOTAL WEIGHT	3868	2803	4772	3386	2355	3234	3351	2869	2804	3388	3759	2943
LOAD PER SQ. FT. OF WING SURFACE	8.8	7.4	8.8	6.9	7.8	7.4	7.7	7.6	6.9	6.8	7.3	7.0
LOAD PER H.P.	9:7	10.0	11.0	11.0	9.0	13.5	14.0	17.9	12.9	13.0	12.9	11.3
LOAD OF BOMBS	0	0	0	0	0	0	0	160	0	0	0	0
NO. OF MEN IN CREW	2	2	2	2	2	2	2	2	2	2	2	2
NO. OF FIXED GUNS	2	1	0	1	1	1	1	1	2	1	1	1
NO. OF FLEXIBLE GUNS	2	2	5	2	2	1	1	1	1	1	1	1
SPEED AT 6,500 FT.	118	116	112	114	115	117.5	116.9	98	108	117	106	97
TIME REQD. TO CLIMB 6,500 FT.	7-12	7-15	8-10	7-40	7-0	11-0	9-18	21-0	8-6	9-30	13-0	11-15
CEILING (FT.)	19,700	20,500	19,400	21,500	21,300	17,500	17,500	13,000	17,000	23,000	26,800	19,700
ENDURANCE (HRS.-MIN.)	1-53	2-45	3-0	2-45	1-45	4-30	4-30	3-30	4-0	3-15	3-30	3-0
— ENGINES —												
NO. USED	1	1	2	1	1	1	1	1	1	1	1	1
NAME	LIBERTY	SALMSON 9Z	HISPANO SUIZA-6BDR	RENAULT 12FCY	LORRAINE 8BD	B.H.P. SIDDELEY	B.H.A. SIDDELEY	R.A.F. 4A	SUNBEAM	FIAT A12	FIAT A12-BIS	FIAT A1R.
ROTARY-RADIAL-VERTICAL-VEE	VEE	RADIAL	VEE	VEE	VERT.	VERT.	VERT.	VEE	VEE	VERT.	VERT.	VERT.
NO. OF CYLINDERS	12	9	8	12	8	6	6	12	8	6	6	6
NOMINAL BRAKE H.P. PER ENGINE	400	270	215	310	250	240	240	150	200	290	290	260
TOTAL H.P.	400	270	435	310	250	240	240	150	200	290	290	260
WEIGHT OF ENGINE	835	456	507	849	547	645	645	600	550	938	838	858
WEIGHT PER H.P.	2.9	1.7	2.4	2.7	2.2	2.7	2.7	4.0	2.7	2.6	2.6	3.2

BOMBING PLANES

	NIGHT BOMBERS							DAY BOMBERS					
	FRENCH		BRITISH		ITALIAN			AMERICAN	FRENCH	BRITISH		ITALIAN	
PLANES —	VOISIN-8Bm2	CAPRONI-3m3	H. PAGE	F.E.2B	CAPRONI 3	CAPRONI-4	CAPRONI-5	D.H. 4	BREGUET	D.H. 4	D.H. 9	S.I.A. 9B	CAPRONI-5
MONOPLANE-BIPLANE-TRIPLANE	B	B	B	B	B	T	B	B	B	B	B	B	B
PUSHER-TRACTOR	P	T	T	P	2T+1P	2T+1P	2T+1P	T	T	T	T	T	2T+1P
WING SPREAD (FT.-IN.)	61-8	73-6	100-2	47-9	72-10	98-2	76-10	42-5 3/8	45-1 1/2	42-4	42-5	30-10	76-10
OVERALL LENGTH (FT.-IN.)	36-1	36-1	62-10	32-3	36-3	43-0	41-5	29-7	29-2	30-2	30-2	31-10	41-5
OVERALL HEIGHT (FT.-IN.)	11-6	13-0	22-0	12-8	12-7	20-8	14-7	10-1	10-10	10-2	9-8	12-4	14-7
WING SURFACE (SQ. FT.)	678	990	1642	498	1055	2185	1420	439	559	436	437	710	1420
TOTAL WEIGHT	4,110	8,752	14,022	3,367	7,726	14,630	11,330	4,097	3,892	3,641	3,669	6,691	10,251
LOAD PER SQ. FT. OF WING SUR.	6.6	9.4	8.5	7.1	7.4	6.7	8.0	9.3	7.4	8.4	8.4	9.4	7.2
LOAD PER H.P.	10.0	16.0	21.0	17.0	14.3	16.8	13.0	10.2	13.0	15.5	15.6	9.7	11.8
LOAD OF BOMBS	220	880	1790	330	880	3300	1760	220	520	370	380	770	660
NO. OF MEN IN CREW	2	3	4	2	3	4	3	2	2	2	2	2	3
NO. OF FIXED GUNS	0	0	0	0	0	0	0	2	1	1	1	2	0
NO. OF FLEXIBLE GUNS	2	5	4	1	2	4	2	2	2	1	1	1	4
SPEED AT 6,500 FT.	75.0	84	80	91	84	76	95	112	110	108	113.6	120	96.3
CLIMB TO 6,500 FT.	17.20	23.60	33-18	18-54	16-00	26-00	16-00	8-36	9-15	13-06	11-24	8-00	13-35
CEILING	14,100	16,400	8,000	11,000	18,000	18,000	14,000	15,000	14,000	13,600	15,500	23,000	21,300
ENDURANCE	4.0	6.0	0-0	3-30	4-15	5-30	5-0	1-48	2-48	4-30	4.30	3-0	5-0
— ENGINES —													
NO. USED	1	3	2	1	3	3	3	1	1	1	1	1	3
NAME	PEUGEOT 8AA	ISOTTA FRASCHINI	ROLLS ROYCE	BEARD-MORE	ISOTTA FRASCHINI	FIAT A12-BIS	FIAT A12-BIS	LIBERTY	RENAULT 12FCX	B.H.P. SIDDELEY	B.H.P. SIDDELEY	FIAT A14	FIAT A12-BIS
ROTARY-RADIAL-VERT.-VEE	VEE	VERT.	VEE	VERT.	VERT.	VERT.	VERT.	VEE	VEE	VERT.	VERT.	VEE	VERT.
NO. OF CYLINDERS	8	6	12	6	6	6	6	12	12	6	6	12	6
NOMINAL BRAKE H.P. PER. ENG.	220	180	300	160	180	290	290	400	300	240	240	685	290
TOTAL H.P.	220	540	600	160	540	870	870	400	300	240	240	685	870
WEIGHT OF ENGINE	882	573	933	502	573	980	980	835	899	645	645	1543	880
WEIGHT PER H.P.	4.0	3.2	3.1	3.7	3.2	3.0	3.0	2.1	2.9	2.7	2.7	2.2	3.0

The Airplane and the Law

by HARRY HIBSCHMAN

Valuable comments upon the laws governing the flying of airplanes and the liability of the owner and pilot in view of cases already tried in court.

EVERY time a transport plane of one of the major airlines leaves the ground for a scheduled flight, there is behind it $50,000 of liability insurance for every passenger on board—$1,200,000 for a load of 24.

This fact may be interpreted in several ways. It may be claimed to show merely that the proprietors of the airlines, like the owners of private automobiles, are prudent men; or it may seem to indicate that they recognize flying as still being an extra-hazardous adventure.

That flying is hazardous no one would be foolish enough to deny, as the record for December, 1936, too sadly shows. On the other hand the safety factor is unquestionably rising. According to Fred D. Fagg, Jr., director of Uncle Sam's Bureau of Air Commerce, it has increased something like 600 percent during the last five years.

According to some non-official statisticians, however, flying is still 50 or 60 times as dangerous as life on terra firma. Whatever the true figures, they need not concern us here. For we of the *genus Americanus* are always ready to take a chance for the sake of getting somewhere in a hurry, though the reason for our haste may not be apparent to a disinterested observer.

We may be softer than our fathers, as the preachers and the professors are in the habit of telling us, but we are not yet too soft to enjoy the thrill of danger. Travel on the airlines is, therefore increasing in a way to gladden the hearts of the operators, and the year 1936 was by the far the best in the history of the industry.

Thousands of us are obviously willing to assume the mechanical, personal and unknown risks of flying. But assuming these factual risks also means assuming the legal risks, and that is a matter of no small significance.

Of all of men's creations, law is perhaps the most ubiquitous. It is present when the doctor gives us our first spank to make us take a breath, and it sticks to us and spanks us ever afterwards. It never leaves us, and we cannot even be buried without its certifying that we are dead.

Of course, then, it took to wings with the first man who flew. When man hopped into the air, so did the law; and in the air it is now, both literally and figuratively. But it is not something new that has taken wings—it is nothing but the old law of the sea and of the land adapted to a new element.

Suits against railroads and other carriers on account of injuries to passengers have long been the main source of subsistence for thousands of members of the legal profession. But even the first case against a stage-coach company in this country is less than a hundred years old.

Such reckless driving! No wonder mommy told us not to play in the beam.

In England the first stage-coach case reached the courts in 1791; and twelve years later an eminent judge sitting in a case involving injuries suffered by a passenger riding on top of a coach when an axle broke and he was unceremoniously thrown to the ground, laid down the rule that the owner of the conveyance had to establish the "landworthiness" of the coach or pay damages, thus recurring, it will be noted, to the analogy of the seaworthiness of a ship.

The leading American stage-coach case is one decided by the highest court of Massachusetts in 1845, and the court's opening words have a very modern sound.

"The question presented," is said, "is one of much importance to a community like ours, so many of whose citizens are engaged in businesses which require their transportation from place to place in vehicles furnished by others; and, though speed seems to be the most desirable element in modern travel, yet the law points more specifically to the security of the traveler."

Its conclusion was that it was the duty of the stage-coach owner to use the utmost diligence and care in providing safe and suitable coaches, harness, and drivers, and that, if an accident occurred from his failure so to do, he was liable for the resulting damages.

The earliest railroad case in which a passenger sued for damages for personal injuries—probably without encouragement from an "ambulance chaser"—seems to have arisen in 1846, when a train of three freight cars and five passenger coaches running on the Erie Railroad between Middletown and Piermont, New York, a distance of about 60 miles, was wrecked because of the derailing of one of the freight cars on account of a broken wheel. According to the record of the judge who tried the case, the train was running at "a high rate of speed" and the passenger coach in which the plaintiff was riding was thrown into a "chasm" "whereby several were killed and many injured."

The "chasm," it later develops, was all of 20 feet wide and 12 feet deep; and the "high rate of speed" was about 25 m.p.h. But that was enough. The court instructed the jury that, when a railroad undertook to carry passengers using "that tremendous power, steam," it was its duty to use "the utmost care and diligence" to avoid accidents.

The jury brought in a verdict for $8,000, a sizable sum for those days; and so began the mulcting of the railroads which endureth even unto the present day.

The law evolved in such cases is the same law that now applies to carriers

(*Continued on page* 71)

Blind Landings Will Be Next

by
DeWITT WENDELL

Landing airliners down invisible runways of radio beams is not a far-fetched vision of the future. The author, a nationally prominent aviation authority writing for POPULAR AVIATION under an assumed name, discusses four systems now being perfected.

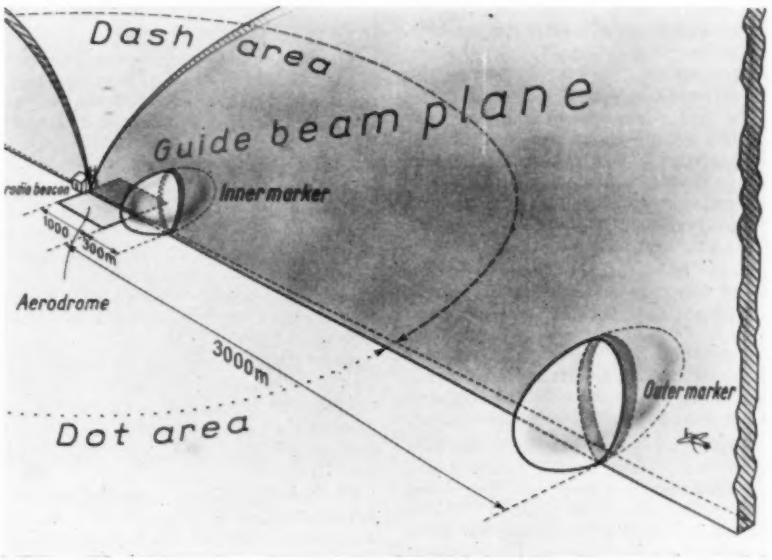
IMAGINE that the year is 1940. You stand in the traffic control tower at the great municipal airport of any large city in the United States. The weather is not exactly CAVU. It is, in fact, another one of those days on which even the pigeons are walking. The ceiling is less than 50 ft., visibility 200 ft.

Does this halt air traffic as it did back in the year 1937? Definitely no. The big four-motored commercial airliners arrive and depart as regularly through the soup as do the crack railroad trains. Nor is anyone particularly excited about the marvel of it.

You hear the airways traffic control directors talking by radio to pilots of incoming and outgoing liners. The calm voices of the airmen report their positions above the field and add "on instruments" quite as casually as they reported flying through clouds when well out on the airways three years before.

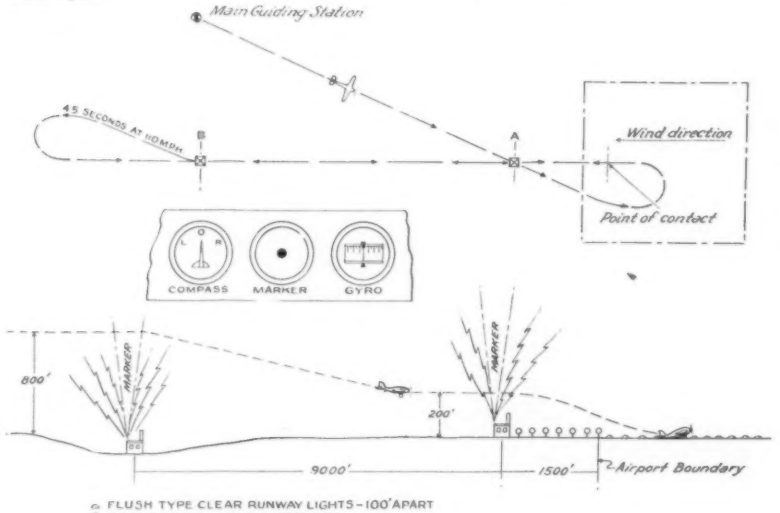
All this is disconcerting to an air-wise observer suddenly dropped in at this field from an earlier year.

Perhaps you recollect how insistent the Air Commerce Bureau was back in 1937 about the strict observance of field minimums. How, when visibility was less than two miles and the ceiling under 500 feet for example, incoming airplanes were ordered to pass up this particular airport. And how departing planes were allowed to take off under low ceilings only after their pilots and company dispatchers had carefully made certain the airports at their destinations were open.



European airlines have been using the Lorenz system (charted above) for years. This is a true "blind landing" system.

There is none of this before you now. The traffic directors are merely regulating the unseen airplanes converging on the field. United Airlines trip No. 19 is ordered to circle at 2,000 ft. over one marker beacon; American Airlines trip No. 4 is circling another beacon at 3,000 ft.; and a Transcontinental & Western Air ship is spotted at 4,000 ft. over a third radio marker.



This diagram shows the operation method devised by Lieut. Albert Hegenberger of the U. S. Army Air Corps. The first American attempt at a blind landing system, Hegenberger's device was tested by Jimmy Doolittle.

Meanwhile an Eastern Airlines ship is given an okay to begin its approach along the invisible radio highroad to the field. The pilot is warned, however, to solve his orientation problem at 1,500 ft. before beginning his final descent because a Northwest Airlines Super-Electra has just disappeared into the fog on a blind takeoff.

Perhaps this picture of commercial flying operations three years hence seems fanciful, fantastic, a bit from a Buck Rogers comic strip. Really it is not. Both military and commercial flying authorities now believe that just such zero-zero operations will become routine within that time.

They base their conclusions upon the success with which they have attacked, thus far, the problem of creating some system for safe landings when fog, snow flurries, torrential rains or other weather phenomena obscure vision.

There are four systems already devised by which airmen flying in cloud can bring their ships to safe landings on properly equipped airports. Two of these systems are definitely blind landing systems—that is, the airman can bring his ship to a landing without ever seeing the ground until he opens the cabin door and steps outside.

The other two are "low approach" systems. These depend on certain instruments and radio aids guiding an airman down below a ceiling which may be no further than 30 ft. off the ground. The airman is expected to follow the

aids provided until he sees the ground and then continue his approach by ground contact flying.

All four of them depend on radio directional beams and radio curtain marker beacons to show the airman his path and warn him that he is approaching the edge of the field at which he is shooting. Indications now are that radio will in future play an increasingly large part in such blind flying operations. Quite probably the next development will be that of a positive radio altimeter to show constantly the distance between the airplane in which it is installed and on the ground beneath.

The Army-Hegenberger landing system is the simplest and was the first to be developed. Its great trouble is that it is so simple, and supplies airmen with so few aids and position checks that only a few superb pilots in extremely stable airplanes have been able to use it.

Lieut. James H. Doolittle, since resigned from the Army, was one of the first flyers at Wright and McCook fields in Dayton, O., where the system was developed by Lieut. A. J. Hegenberger, to make a solo take off and landing entirely under the hood. Doolittle, of course, used the Hegenberger system.

He got off, flew away from the field on the radio beam, circled, returned, and managed to make a landing. The ground contact, however, was a rough one and the plane bounced heavily several times before he got it stopped. The ship was a Fleet trainer and it stood up under this beating.

Later that day one of his fellow pilots said to Doolittle: "Jimmy, we all know you are the best flyer in the world. We knew you could do that before you started out but none of the rest of us can so what does your flight prove?"

"Why," exclaimed Doolittle, "it proves that the Fleet has a damned fine undercarriage."

This is feeling about the Hegenberger system that most of the airmen who have flown it retain. On the ground there is a directional radio range station which projects a beam along the runway down which the instrument landing is to be made. Just outside the field there is a low powered short wave marker beacon which sends up a thin curtain of signals at right angles to the runway.

In using the Lorenz system, the pilot stays "on course" by watching this instrument.

The purpose of this marker beacon is to warn the pilot that he is almost at his field, that all is clear ahead of him, so he can close his throttle and prepare for ground contact.

In the airplane are the usual flight instruments, turn and bank indicator, rate of climb, altimeter, a magnetic and gyro compass, a radio compass, a special receiving set for the marker beacon and receiver for the directional beam signals.

The pilot approaches the airport using his radio compass or the usual radio range and then tunes to the frequency of the field localizer beam. He flies over the transmitter and determines along what leg of the beam the marker beacon is located.

Having found this course he flies away from the field for three minutes, makes a 180 degree turn and flies back again, simultaneously beginning his descent at a pre-calculated rate which should bring him over the marker beacon at a height of 50 ft. or less.

If all goes well the pilot follows the localizer beam exactly, passes over the marker beacon and closes his throttle as he hears the marker signals or sees the marker beacon light an electric bulb on his instrument board.

He then watches his altimeter and airspeed, allowing his ship to sink as slowly as possible and yet retain flying speed. He jerks down the tail as soon as the wheels touch. A few pilots have become expert enough on this system to make passable landings but most airmen find the landings frightening and uncomfortable experiences.

The airlines rejected the system as an answer to their needs for landings with passengers as not positive enough and as requiring too high a degree of personal skill in the pilot.

The second low approach system was developed by C. Lorenz—A. G., of Berlin, a subsidiary of the International Telephone and Telegraph Corporation. It has been in service in 11 European countries, in Japan and in South Africa for a period of just over two years, and a number of European airline pilots, notably those of the Deutsche Luft-Hansa, Swissair, and K. L. M., the royal Dutch airline, now use the system to land passengers when conditions of visibility are poor.

The Lorenz instrument landing system is somewhat more complicated than the Hegenberger, but it provides considerably more information for pilots who use it.

Equipment of the Lorenz System consists of two units, one on the ground, one in the airplane. The airport equipment provides an ultra-short wave radio field about 20 miles around the airport. Upon entering this field the pilot locates an ultra-short wave guide path which leads him directly to the air field.

This path is narrow and transmitted so that it lies along the line of a certain designated runway. These same signals in addition to being directional also form

(*Continued on page 62*)

Flying by the Stars

by

Comm. P.V.H. Weems (U.S.N. Ret.)

The author gives Amy Johnson, famous British aviatrix, a few pointers on "shooting the stars."

THE principle of celestial air navigation is exactly the same as celestial marine navigation by which thousands of ships are continually navigated over the seas. In fact, there is greater potential need and use for celestial navigation in the air than at sea.

In the first place a ship can hold a course and log her speed with considerable accuracy since the marine compass and speed logs are extremely accurate and the ocean currents relatively slow. On the other hand, aircraft compasses and air speed meters are less accurate, and the air currents are relatively much greater than sea currents.

Another important factor in celestial air navigation is the difficulty of sighting landmarks when flying at altitude and the resulting need of a positive means for fixing the plane's position above the clouds. The only present means for fixing a plane's position when flying above a cloud is by radio position finding and celestial navigation, and the latter only is here considered.

Strange to say, little effort has been made to accomplish celestial navigation aboard ships at night. The best apparent reason for this is that "nothing is done now because nothing has been done before." At any rate it is an established fact that night time with the many stars available offers the best means for fixing a ship's position by celestial observations.

Our forefathers had more reason for not attempting to do marine celestial navigation since they did not have a suitable sextant for this purpose. Thanks to the rapid development of the "bubble sextant" for air navigation, mariners now have an additional means for fixing positions when the natural horizon is obscured. The principal difficulty met with in the use of the bubble sextant is the

(*Continued on page 60*)

"....Clear and Unlimited"

by SWANEE TAYLOR

And now doth our worthy scribe address himself in no uncertain terms as to the present condition of racing in the U. S. A. And he speaketh the truth as we see it and have seen it for nigh on twenty years.

LAST month I talked, as is my frequent habit, entirely out of turn. You possibly recall that I waxed a bit bitter about what I felt was unwarranted interference by the Department of Commerce in the proposed Lindbergh Memorial Trans-Atlantic Race. Well, to get straight to the point, the dear D. of C. had nothing to do with the decision; Colonel James Monroe Johnson, the Ass't Sec'y, was merely the hapless horn for our Supreme Trumpeter. Yes, the White House pressed the middle valve down and Col. Johnson made the music!

It should need no mention that my deep-seated apology goes to Col. Johnson. That I could have blamed him grieves me as much as it mortifies me. And my self-abasement I want to reiterate a deep admiration for the Col's soldierly willingness to shoulder blame for his superior officer. Only in the military, and in politics, can you find such sweet sacrificial willingness. However, you've got to admit that Col. Johnson's statement banning the race, listened an awful lot like the vacuous stuff that comes out of Pan-American's publicity bureau. S'help me, if I weren't so doubly sure of Col. Johnson's inviolable devotion to the Public Service I'd be tempted to believe that it did come from there.

Now I've got to write . . . .

An Open Letter to Amy Mollison . . .

Now See Here, Young Woman:

Not only is it a bit thick for you to jump all over our beautiful Bureau of Air Commerce, but you are jolly well in error. Aim your resentment, if you must, at the suave, potent State Department—not at our little old lady, Mummsy Commerce.

Also, you might do well to save half your ire for your own department of government that lends such sympathetic ear to Imperial Airways, the other half of the imminent trans-Atlantic air monopoly. For, your own people had as much to do with killing the race as we did. So my advice, honey, is to forget anything ever happened. Else put it down as another diplomatic dirty trick and let it go at that.

Of course it is hard for you, of all people, to understand the gross governmental—yours and mine—injustice in willfully paving the way for what our President has classified as, ". . . Forces of selfishness and lust for power." But dear Amy, you've got to keep in mind that the men sitting on high today are remnants of a dying breed; they are the last of the kiwi Mohicans. Aviation, and the people in it (both good and bad),

Our Swanee Taylor now beams upon you for the twenty-fourth time.

remain utterly unfathomable to their downhill minds. Hence we shouldn't blame them for their ignorance, stubborn and staggering though it be. When they've gone (it won't be long now, Toots), our ceilings will lift and civilian flying will rise to loftier heights. With the coming of a pilot-President a man will be able to fly around in this country when and where he pleases and with a minimum of govt. molestation. (A little bet on Gov. Earle right now might win you much later.)

Personally, dear girl, I'm sorry that they called off the race to Paris. It would have been a convincing supplement to Dick Merrill's round-trip to London; a vivid demonstration of Aviation accomplishment in the ten short years since Slim Lindbergh came out of the West to startle the world with the greatest feat in the history of man.

To be sure, it would have dimmed the garish publicity currently by being whooped-up by Imperial-Pan American Airways, thereby putting a slight crimp in the trading of shares. Which would have been quite unthinkable—to the stock manipulators.

Oh, well, they have arranged a substitute derby for you which is a comfort, and I hope you win all three first places. Come back over to see us some time. Meanwhile, keep your chin up and do try to keep your political philosophy mellow.

Hugs and Squeezes.

Memo to Frank Tichenor . . .

Hey, Frank, won't you please have that man up at your place lay-off calling our really very popular aviation magazine the Model Builders' book. It's pretty low stuff, Frank, far beneath the dignity of a great publishing house. Tell your advertising department that desperate tactics won't help a bit, and that a liar is an abomination unto the Lord.

Besides, Frank, shooting from ambush, as you surely know, is considered stinking sportsmanship and doesn't pay. Of course you know it, Frank, and you agree absolutely. But there's one thing you don't know, and it is with considerable reluctance that I speak of it. As a matter of fact I wouldn't say a word were it not for the panicky things your advertising dept. says about us. However, this "model builders' book" stuff has come back once too often and I've got to tell you that I always spring to your defense at the drop of the hat. Frank, I get mad as hops whenever I hear anyone in the Industry laughingly nickname your nice little magazine, "The Greaseball's Guide."

It isn't a greaseball's guide, Frank, no matter what anybody says. Anyhow, there's a place in the Industry for a publication catering to the needs of the vast army of riggers and mechanics!

Who's Killing Cock Robin? . . .

Those of us who have been watching aviation meets and air races for the past five years or more have viewed with growing alarm the steady decline of pilot-status at the sundry promotional shindigs. Each succeeding year managements have been giving participating pilots, their wives, coarser and coarser treatment, not to mention less and less money. Until, today, most air meets are merely places to pick up a dollar or two—mothing more.

Naturally, with the lowering of regard for the people who stage the show the performance *esprit* has waned in direct proportion. No pilot can whip himself into an enthusiastic mood when he knows that his reward will be poor at best; that the promoter is bound to be the big winner.

Just why the N. A. A. chimes in harmoniously with the managerial plans is still a bit of a mystery. They claim it is because of their hope and interest in speed development in America. Yet they have allowed racing to decline to a point where there are less than ten racing ships in this country today. What's more, the racing pilots are tossing up in disgust. Harold Neumann got smart and joined TWA, Art Chester flew his last race at St. Louis and Roger Don Rae is waiting for an airline berth and the economic security that goes with the job. The rest of the boys, too, are

beginning to retch slightly at the pompous insanities of the "contest committees" at the various meets. (Ever hear "Doc" Kincaid put on his dying duchess act at a pilots' meeting? It's rare fare, friends.)

And to prove my point, let me remind you that when Roger Don Rae cracked-up in St. Louis, (ensuring capacity crowds for Sunday and Memorial Day), not a living soul connected with the N. A. A., or the management bothered to make a 5c telephone call to find out if the patient was in bed or in the morgue. Now do you see what I mean?

A Lotta Scud . . .

If the Cleveland Air Races want "name" acrobatic pilots this year they're going to have to pay real money. Fordon-Brown will turn over their National Air Shows if the management will stop talking jelly-beans and speak in terms of dollars. . . Did you know that the elapsed speed between New York and Buenos Aires, via good old Pan-Am, is 31 m.p.h.? (No wonder the Germans get down there a day ahead of us). . . Official hardheadedness in the Post Office Department stands between profit and loss for that airline between Detroit and Washington. The P. O. sturdily insists that they make a daily trip each way which arrives at 2:57 and 4:45 A. M. respectively. Not a chance for passengers and they've got to use multi-motor equipment. . . Did you ever try to doze on an airliner while the dear little hostess jabbered away at a lady passenger? (All the men were asleep and she had to talk.)

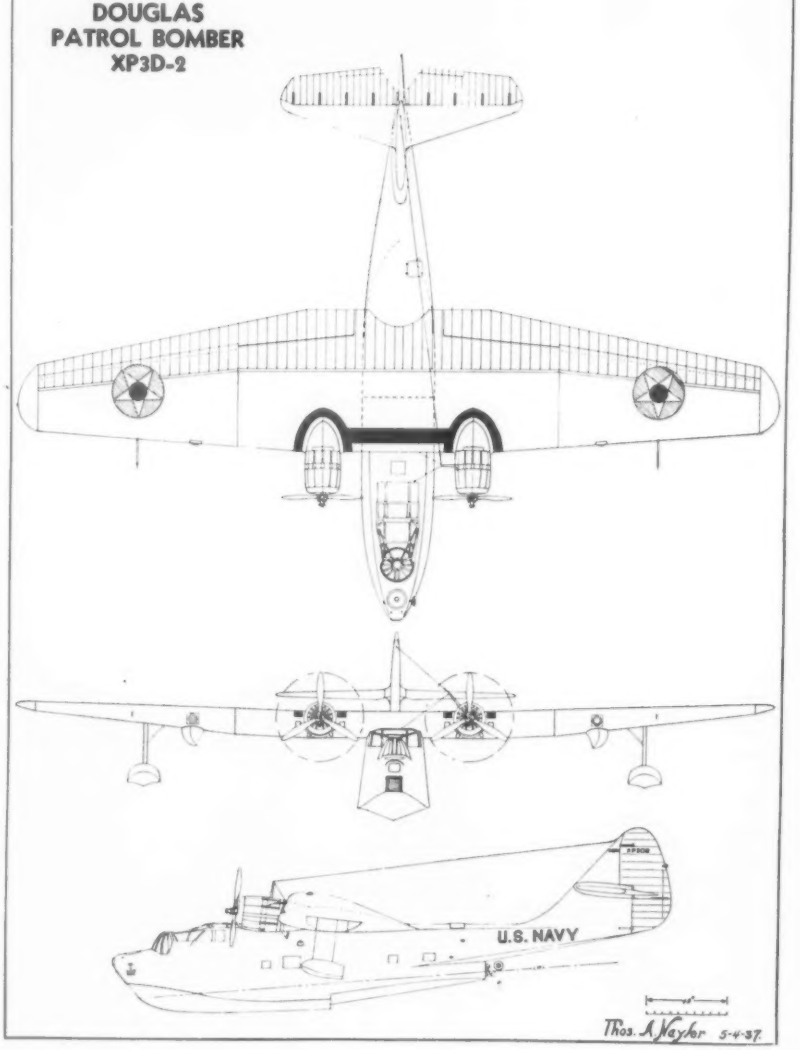
The Tenth National Championship Model Airplane Meet comes up in Detroit July 7-12, and should furnish both sides with ample ammunition for the scrap over whether they should allow gas models. (Here's one I'm not going to get sucked into).... The Fox Fur Trappers Assn., a guild of gay cabelleros, awards an annual Prize Pelt to the Post making the biggest hit with the ladies. This year's award went to Wolverine Post No. 2, consisting of pilots of the Michigan Nat'l Guard Squadron, who did their "trapping" on the edge of Wayne County Airport.... Roger Don Rae came within hundredths of a second of equaling the average made by Michael DeTroyat at Los Angeles. (Why was nothing said?) And Roger was flying a five mile course, against the gallant Frenchman's larger, ten mile circuit. . . . And does anyone know what that hard-boiled D of C doctor gains by denying 62 Aeronca factory workers a group price on their flight physicals? It must be swell to be able to throw obstacles in the paths of people who want to fly.

The Industry can afford to take time off and thank Leighton Rogers, Aero C of C president, for the first fruits of his well planned campaign to accomplish things for the Industry. That silly export license fee has, thanks to our prexy been reduced to $100 . . . I sort of agree with TWA's Johnny Walker that airways beacons are needless expense. Who in heaven's name uses them in this day of radio navigation. Maybe they keep 'em burning for the angels. . . . Two seat cushions and three sets of floorboards have been replaced in the Fleet in the aircraft exhibit at Franklin Institute. Which gives you a general idea of how many people have climbed in and out of the ship. Not a thing else was damaged, which is a definite idea of how honest they are in Philadelphia. (Remember the barnstorming days when folks would steal the prop if they could get it loose?) . . . Proof of something or other: There is no tombstone on Eddie Stinson's grave—just a lot of weeds.

If it is true that the Long Island Aviation Country Club membership opposed letting the Intercollegiate Flying Clubs hold their meet on the club field then that club ought to be blasted off the face of the earth. This sort of snobbishness is what makes it hard on people who earn their own money.

U. S. Navy Gets New Douglas

NAVAL test pilots are playing with a new "guinea pig" these days. It's the Douglas XP3D-2 patrol bomber recently developed from the Douglas DF boat. Though the strictest Naval secrecy is maintained around this new patrol bomber, it compares in appearance so much with the DF that some idea may be gained by describing the latter. The DF is powered with two Wright *Cyclones* that develop a total of 1,700 h.p. Another comparison might be the DF's seating capacity of 32 passengers. By multiplying the 32 passengers by 170 (average weight per person) one might get some idea as to the amount of weight in bombs the new Navy boat may carry. At this writing, no photographs were available.



Reserved Seats in the Air

by G. R. BARROWS
Superintendent, United Airlines Reservations Department.

Not many people know just what must be done by an airline passenger to assure himself of a seat on the next plane to where he's bound. It may look complicated but it's not. Just pick up your telephone.

IN HIS office high in a New York skyscraper, Mr. John Jones has just completed a phone call to his office in Seattle.

A situation has arisen in connection with his lumber interests in the Northwest and his immediate presence in Seattle is required. He had told his Seattle manager, "Bill, you have Nelson come in from the mill and wire De Haven at San Francisco to be in your office for a meeting at two o'clock tomorrow afternoon. I'll fly over tonight. Plan to have lunch with me."

Pushing a buzzer on his desk, Mr. Jones' secretary enters.

"Get me a seat on the next plane to Seattle," he directs. No questions were asked for Mr. Jones is a constant air traveler and his secretary is thoroughly familiar with getting a seat for him.

Five minutes later she is back to report, "The next plane leaves the airport at 5:10. The ticket is being sent over right away and the airlines limousine will pick you up at the Hotel Pennsylvania at 4:15."

Looking at his wrist watch, Mr. Jones muses. "Hmm, that's service. Well, thank you."

To Mr. Average Air Traveler it's all as simple as that, but let us take a little visit behind the scenes to see what was going on during the five minutes that Mr. Jones' secretary was gone from the office. Returning to her desk she dialed the airline's number in New York and quickly.

"I want to make a reservation."

"Thank you. I'll connect you with the reservations department."

Every precious seat on an entire airline is carefully charted by this department. This is the "nerve center" of a modern airline.

"Mr. Brown speaking."

"I want to make a reservation for Mr. J. L. Jones to Seattle on the next plane."

"Thank you. The next plane leaves at 5:10 p. m. Shall I have the ticket sent over."

"Yes, please. To Suite 2001, Graylock Building."

"Shall we pick Mr. Jones up at the Pennsylvania Hotel at 4:15."

"That's correct and thank you."

In the reservations department where a corps of experienced airline men are busily engaged in a large room, there is a full wall of charts and shelves. Nearly a dozen phones are in use all the time. As soon as Mr. Brown received the call from Mr. Jones' office, he went direct to the chart for the next schedule to Seattle. There was no necessity to lay the phone down, since this reservations department has the overhead type of phone which enables the clerk to walk the entire length of the room and take the phone with him.

By looking at this chart he knew immediately that New York reservations had a seat open all the way to Seattle and this was assigned to Mr. Jones. The entire operation took less than a minute. And so, because of the highly-perfected system of reservations, Mr. Jones steps into the airport car after completing a full day's work at his office. The next morning he is in Seattle in plenty of time for his business meeting in the afternoon.

Quick reference, complete tabulations of each seat on each ship on the system are in these card holders. The reservations "dispatcher" can tell instantly how much space there is available on any of his line's ships.

The present method of handling air transport reservations is indeed a far cry from the system, or lack of it, employed in the early days of airline flying. In those days, however, the volume of traffic was so slight that the matter of reservations was by no means a problem.

But, in 1936 the airlines of the nation carried more than a million passengers. This figure will be excelled in 1937. In turn, each successive year will mark an increase over the previous one and it is impossible to predict when a constant traffic flow will be reached or what the figure will be.

It was in 1930 that the first nation-wide and unified reservation chart system was adopted at San Francisco,

and this same system is the basic pattern of the present one used for transcontinental flights.

The yardstick of reservations importance is best gauged between 1930, when 50 percent of the traffic business was handled direct with the passenger and, in 1937, when 85 percent of the business originates on the telephone.

Eight large reservations offices are now in operation by United Airlines. One is in New York, as we have seen, and others are in Cleveland, Chicago, Salt Lake, Los Angeles, Portland, Seattle and San Francisco. Each city has its own reservations manager serving directly under the superintendent in Chicago.

Even the layman will appreciate the importance of accuracy in the reservations department of any airline. Unlike other forms of transport, the space available on air transport planes is limited and only a given number of seats can be sold.

For example, between New York and Chicago on the nonstop service, there are 14 seats on the Douglases. Should a 15th ticket be sold by an erring reservations man it might be necessary to put on another plane to carry the fifteenth passenger at great expense to the airline. Not so with trains. In the event of a railroad oversale, it is a simple matter of attaching another car.

Hence, an important detail of reservations for coast-to-coast and border-to-border routes is a matter of space control. All transcontinental space is controlled at Chicago and Salt Lake and, from these offices, seats are sub-allotted to the many stations. On the west coast this space is sub-allotted from Salt Lake to Los Angeles, San Francisco, Seattle and Portland. Chicago sub-allots its space to Omaha, Cleveland and New York. With this system a complete picture of the space situation is had at all times by both the Chicago and Salt Lake offices.

An idea of the amount of detail required for the accurate handling of reservations is best seen in the fact that United Airlines controls approximately 650 seats a day. A manual called the "reservations guide" has been published and this is a company handbook for all reservations men. At an instant glance it tells the space allotment on each trip. A quick-glance chart on each man's desk tells the one-way and round-trip fares and similar information between all cities in the country linked by airline service.

The element of time in making reservations is conquered by these short-cuts to efficient handling of each passenger. Each call receives individual attention and yet a reservation can be made at any office within the space of 60 seconds.

The greater inter-office communication is between New York and Chicago and these two points are connected by a telemeter system, this being an instant two-way teletype system. Should the New York office desire the release of a seat being held westward by Chicago,

(*Concluded on page 70*)

How the Barkley-Grow Wing Looks

These are the structural members of the Barkley-Grow wing assembled.

THE above photo shows very clearly the method of assembly used in the construction of the Barkley-Grow multi-spar wing or, rather, the multi-cellular wing. We published a full account of the theory in our last issue. As will be seen, the failure of one or two members means but little to the strength of the wing.

Nearer to Perpetual Motion

BENNY PETROFF, native son of Bulgaria, claims the distinction of inventing and construction a self-propelling airplane that will fly indefinitely without fuel or energy of any sort. The wings flap and flutter in the Bulgarian breezes and—away she goes according to what we hear.

It would be rather interesting to discover the following facts, to wit: (1) Whether it did fly; (2) Whether the flight was due to thermals, and (3) The name of his press agent.

Benny Petroff and his aeronautical innovation that licks the physics books.

Dragons Are Flying!

DRAGONS have taken to the airways! If you have any doubts, drop a line to China National Aviation Corporation's crack airman, Capt. Chile Vaughn.

One bright sunshiny day recently Captain Vaughn was flying a C.N.A.C. Dolphin in to Canton on the line's afternoon hop. Everything was going fine, the passengers were quiet and contented and the veteran airman was anticipating a choice Cantonese dinner that awaited him.

Suddenly Captain Vaughn stared, gulped and yanked the Douglas' controls far over to one side of the cockpit. Out of the setting sun a huge red, tail-swishing dragon had appeared directly in the airliner's path!

The frightened pilot streaked for the Canton landing, slapped the amphibian down on the river alongside the city and made a breathless report about an air-going monster that "breathed flame and smoke from huge nostrils."

But the C.N.A.C. field manager at Canton is surprisingly practical for a man living amongst the ancient glories of China. He listened to Captain Vaughn's excited story, thought a while, then sent two field men out to hunt down the culprit responsible.

"Doggone it," he growled at the astonished pilot, "I'll teach those kids to stop flying their blankety-blank kites around this airbase—kite-flying season or no kite-flying season!"

New Flight Book

NOT to take the place of, but to supplement the many good books on the theory of flight is the pamphlet on that subject put out by the government.

Its full title is "Theory of Flight," Air Corps Technical Regulations No. 1170-205, March 1, 1937, for sale by the Supt. of Documents, Washington, D. C., for 10 cents per copy. It is an excellent text for schools, clubs, etc., and a reference book for the busy instructor.

Size:—43 pages. Contains such dope as,—development of wing or airfoil, the complete airplane, function of tail surfaces, propeller characteristics, stability, performance, and dynamic loads and factors of safety in aerial maneuvers, the latter chapter of particular interest to the amateur pilot who has reached the stage where he believes in "trying things out."

How Many Sparks Occur

A WHOLE lot of sparking is done by the magnetos of a 9-cylinder engine when running at an assumed speed of 1,500 r.p.m., and there would be twice as many more with a two-cycle engine.

At 1,500 r.p.m. there are 6,700 sparks per minute or: 60 x 6,750 = 405,000 sparks per hour. If the ship flies steadily for 10 hours at this speed, then the magneto must furnish 4,050,000 sparks for the entire trip.

Allison Engine Passes Tests

New chemically-cooled 1,000 h.p. 12-cylinder engine is developed to meet Army Air Corps requirements and passes its 150-hour test.

FOR the past several years, intensive development work by different aircraft engine manufacturers has been under way to meet the Army Air Corps requirements and to pass the 150 hour type tests for aircraft engines of 1,000 horsepower normal rating. The Allison engine was the first to pass the Army 150 hour test for engines of 1,000 h.p. or larger.

It is interesting to note that the Allison engine is a Vee type twelve cylinder design, chemically cooled instead of the widely used radial air cooled design that has done so much to date to enhance the progress of American aviation.

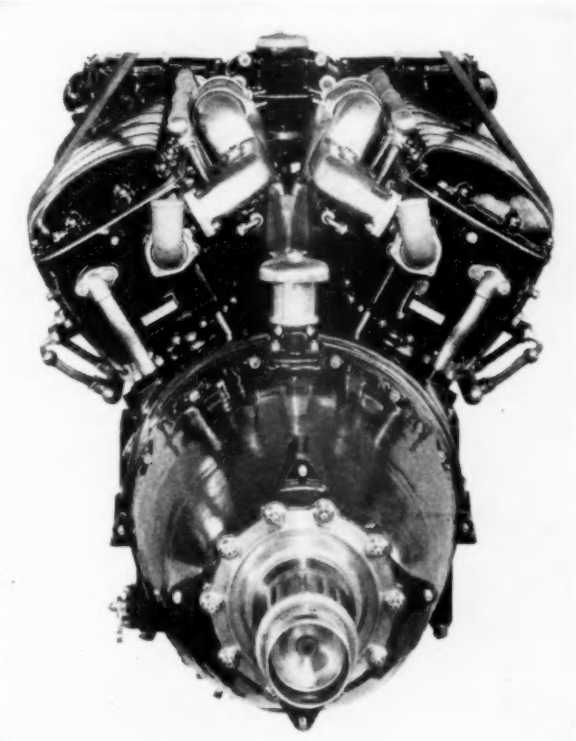
The chemist has contributed to the new era of powerful aircraft engine designs by developing synthetic coolants that have high boiling points and low freezing points. These coolants have replaced water which has been generally used for liquid cooled engines in the past. Ethylene Glycol is the coolant used in the Allison engine. It has a boiling point of 387° F. thus permitting more effective cooling radiators to handle the heat transfer from cylinders to atmosphere, than water which boils at 212° F. and therefore requires larger radiator area.

This new engine is reported as especially adapted for high altitude flying as it permits a very practical installation of a turbo supercharger. The turbo supercharger is an American invention sponsored by the Army Air Corps comprising a turbine compressor driven by the waste exhaust gases of the engine. It compresses and delivers to the carbureter at sea level pressure the rarefied atmosphere at higher altitudes to provide the air required for combustion in the engine cylinders.

When the engine is supplied with air at sea-level pressure it maintains sea-level power output. Up to 25,000 feet for which level the turbo supercharger is designed, the Allison engine provides a 1,000 horsepower. With such equipment a plane is capable of very rapid climbing and very high speeds.

Both of these qualifications are very valuable for a military airplane. The chemically cooled engine has a very small frontal area—less than six and one-quarter square feet. Air cooled radial engines now in general use but of lesser power output have a frontal area of 16¾ square feet.

The small frontal area of the chemical cooled engine provides for ideal streamlining of the plane which in turn adds five or more percent to the increased speed of the plane for the same expenditure of engine power.



Head-on view of the new engine.

While high output chemically cooled engines and the higher speed planes will definitely cost more than planes and engines now in use, it seems likely that the advantages both as to speed and the superior strategy of high altitude flying and rapid climbing for military and the economy of long distance transport will more than offset the higher first cost.

It is generally agreed that in airplanes, greater useful and available engine power and economical higher speeds are important factors contributing to increased safety of flying. Both factors offset some of the hazards of bad weather either as to ice formation and arriving at the destination before marked weather changes take place.

Thirty-five years ago the Wright brothers at Dayton, Ohio, designed and built the first engine that flew an airplane. It was a four-cylinder water-cooled engine built of aluminum, cast iron and steel. It developed 30 h.p. and weighed 180 pounds. Today we have the last word for the moment from the Air Corps—a 1,000 h.p. aircraft engine weighing 1,275 lbs. The engineer, the metallurgist and the chemist refuse to admit that the future is more venturesome [illegible] further improvemen[illegible] than the past—tomorrow we may hear of further accomplishments of the engines and planes for new eras of safe flying.

For several years many aviation technicians have felt that some of the European nations had the more modern aircraft engines particularly for military purposes. The Rolls-Royce *Merlin* engine has demonstrated extraordinary performance as to speed for British military aircraft. The U. S. Army rating of 1,000 h.p. normal for the Allison engine brings back the lead to America for the most powerful lightest weight aircraft engine.

The development and construction of this new engine has been under way for almost five years by the Allison Engineering Company at Indianapolis, a division of General Motors, devoted to development work. The Air Corps Power Plant Section at Wright Field has purchased a number of these engines and carried through the intensive testing of the different designs that led to the engine specification now being released for production. These specifications are quite interesting in view of the changing engine situation.

In addition to the test work carried on in the engine laboratories, Wright Field installed a test engine in an experimental test airplane. This test plane with the 1,000 h.p. Allison engine to date has flown over 100 hours with satisfactory performance as to power and smoothness in take-off and in flight and particularly good starting in cold weather. The ceiling or maximum altitude reached by this test airplane which is not equipped with turbo-supercharging was made by Lieut. B. S. Kelsey of the Flight Section at

Wright Field. He reached an altitude of 26,400 feet.

SUMMARY OF SPECIFICATIONS

Allison 1710-C6 Vee-Type 12-cylinder Engine Specifications:

Bore 5.5, stroke 6.0". Displacement 1710 cubic inches, overall length 94.47", overall height 50.94", overall width 28.94". Geared, chemical-cooled, normal and take off rating 1000 horsepower at 2600 r.p.m. on 87 octane commercial fuel. Compression ratio 6.0:1, blower ratio 6.75:1, propeller shaft ratio 2:1.

Weight with magneto, carbureter, coolant pump and pipes, exhaust stack flanges, tachometer, fuel pump, vacuum pump and generator drives and provision for hydro or electric controllable pitch propeller and governor—1280 lbs. or 1.28 lbs. per horsepower.

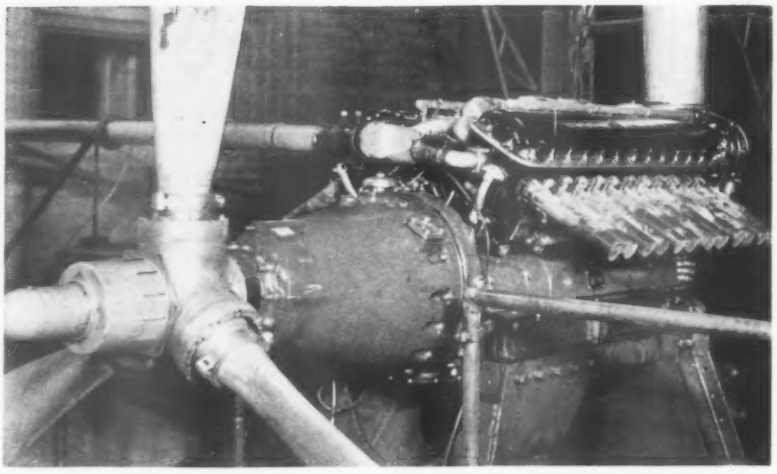
CONSTRUCTION

Crankshaft—chrome nickel molybdenum steel forging.

Crankcase—aluminum alloy casting, upper and lower halves.

Cylinder assemblies—cast aluminum alloy heads and jackets with steel sleeves.

Pistons—forged aluminum alloy with 3 compression and 1 oil rings.



The new Allison engine is shown here on the test stand. The rigid 150-hour Army Air Corps test run was made on this stand.

Piston pins—full floating type.

Connecting rods — chrome nickel molybdenum steel forgings. 1 section machined and polished all over.

Bearings—Allison lead bronze steel back for crankshaft, connecting rod and reduction gear.

Accessories—Scintilla double magneto and distributors, Stromberg carburetor, BG spark plugs and Rich valves.

How Not To Operate an Engine

by
Edwin B. Murphy

THE basis of all good arguments is found in the type of incident having the most unusual "twist". Hence, I relate the story of a Pratt & Whitney *Hornet* engine that flew 15 miles on seven cylinders.

At about 8:30 o'clock in the morning of Feb. 29, 1936, two Vought observation ships of the S-U type, took off from the field of the U. S. Marine Squadron on the island of St. Thomas in the West Indies, and roared off into the west, on a hop to San Juan, Puerto Rico, some 65 miles distant.

I was the only passenger on this trip, and I had planned to remain in San Juan for the week-end so I sat with eager anticipation of those tall, frosty mint juleps served at the Aquarium. The two ships droned steadily over the blue Caribbean, past the sun scorched island of Culebra, and on toward Puerto Rico.

Only an early morning flight over the Islands could describe the unforgettable beauty of the blue Caribbean with the sun booming up over the eastern rim of the horizon to bathe the mountains of P. R. in the dewy freshness of a tropic morn.

The captain and I, occupying the leading ship, were aroused from our observations of tropical beauty, when the motor missed. Glancing at the instruments, the captain noticed the tachometer drop slightly, but all other instruments read normal and the setting of the throttle had not changed.

Again the motor missed, and this time a slight vibration could be felt, which grew with the now steady sputtering of the engine until we cast worried glances at shark infested waters below and the dim outline of Cape San Juan, still ten miles away.

Slowly, we crept toward the Cape, and as it rolled below us, our sigh of relief was cut short, when a quick glance ahead showed a small line squall that cut off San Juan, this would force us to go to the left over the mountains or fly a few miles out to sea.

Our decision was made quickly, however, when I thrust my head over the right side of the cockpit and quickly found my face and goggles covered with oil. Glancing toward the motor, we could see number three cylinder jumping around like an old man with St. Vitus dance, apparently held in place by the anti-drag ring.

One last look at the sun-bathed world behind, and down went the nose of old 9121, and down with it went two very prayerful airmen.

Ages of mental agony, and we shot out into the cool, sweet air beyond the squall. Quickly the captain nosed up for swift climb. The engine was vibrating badly now, but the needle finally came to rest at 4,000 feet.

San Juan was still 15 miles distant, when, with a loud bang, number three cylinder blew off, carrying the intake with it. The ring cowling was thrown up and jammed below the propeller hub between the engine and propeller, its top protruded about a foot and a half above the motor, and waved in the wind like the stiff collar of a shirt. Oil streamed past, bathing the right side of the ship back to the tail. Pieces of metal from the broken cylinder, tore large holes in the right wings.

The knowledge that the ring cowl, if caught in the whirling prop, might be thrown back, causing damage to the upper wing or perhaps tear out the center section struts, prompted us to busy ourselves by checking our parachute harness while we nursed visions of being ushered into the presence of the reigning King Caterpillar.

The unusualness of our situation was intensified when a glance at the tachometer showed the old *Hornet* putt-putting along at the rate of 1,700 r.p.m. (At this point I remind you that truth IS stranger than fiction.)

About five miles from San Juan, the connecting rod of number two cylinder decided to follow parts of number three, and with only seven cylinders, the old *Hornet* really started to raise a fuss. The wings shook and danced, the wires sang with an odd, deadened sort of flutter. Although flying speed was easily maintained, vibration was extremely bad and increased fast, until the captain cut the switch and nosed down for a sweet dead stick landing on the Pan American Airways field.

Shakily we lit cigarettes and loudly praised Pratt & Whitney. A new motor, another ring cowl and a few patches, and old 9121 went back into service, and is still operating as far as I know.

END

Italy Breaks Another Air Record

Already holder of many world speed records, the world altitude record—held once before by an Italian—is taken from the British by an Italian schoolmaster.

ITALY is the new holder of the world's airplane altitude record. England held the record for a little more than seven months when, on Sept. 28 of last year, Squadron Leader F. R. D. Swain climbed a special Bristol monoplane 49,944.121 ft. But on May 7 of this year, Lieut.-Col. Mario Pezzi, chief of Italy's famed High Altitude School at Guidonia, cracked the British mark and set what is liable to be the world's altitude record for airplanes for some time to come: 51,348 ft.

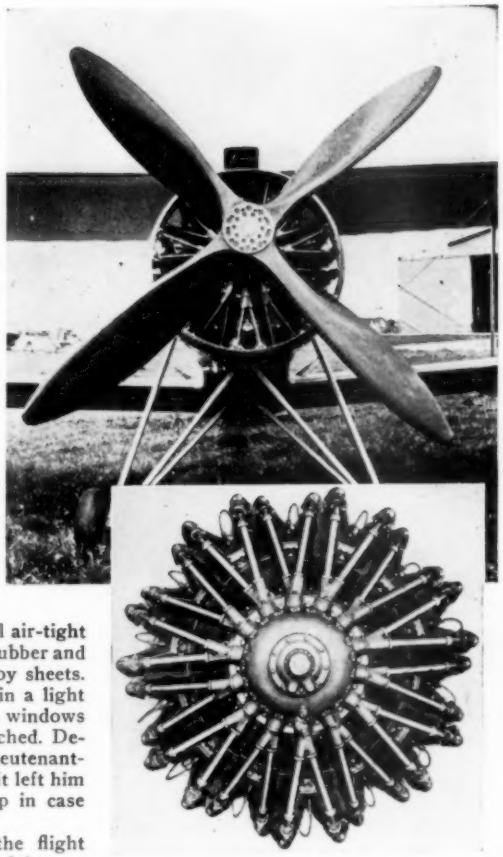
Of particular interest to the air-minded is the equipment used by Lieutenant-Colonel Pezzi. Unlike many altitude record-seeking machines, a biplane was chosen to make the climb with. The ship was specially designed by the Caproni company and is known only as the "161". It is a modification of the "113" that, in April of 1934, set what then was the world altitude record of 47,340 ft.

Rather than use a monoplane for the record attempt, the Caproni company chose the biplane, trusting its success to the machine's lightness. Instead of using an Alfa Romeo engine which is standard on the Model 160, the altitude machine was equipped with a heavier Piaggio engine that developed 710 h.p. at 23,616 ft. and 140 h.p. at 45,920 ft. The extra power supplied by the Piaggio, however, served to overcome the added weight.

The Piaggio engine used in the record flight is a radial air-cooled 14-cylinder double row engine. It is a standard Piaggio engine to which only minor modifications were added. The compression ratio was increased so that the theoretical power at sea level was approximately 1,800 h.p. Piaggio engineers, in order to test the engine's performance for the flight, operated it in a special tunnel in which all the conditions that exist at 39,360 ft. (extremely low temperatures and pressures) were accurately duplicated.

The 51,348 ft. climb (9.70 miles) was made by Lieutenant-Colonel Pezzi in atmospheric conditions that were far from ideal. When the Italian airman reached the new record altitude, he reported a temperature of 54 degrees below zero. The pilot's compartment in the special Caproni biplane was a conventional open cockpit in which the pilot wore a special air-tight electrically heated suit made of rubber and fabric reinforced with light alloy sheets. The pilot's head was enclosed in a light alloy cylinder with heated glass windows to which oxygen pipes were attached. Despite its seeming bulkiness, Lieutenant-Colonel Pezzi's high-altitude suit left him free to make a parachute jump in case of trouble.

Aside from the fact that the flight officially smashed the world height record, there was little excitement at the Italian High Altitude School when Lieutenant-Colonel Pezzi landed. High altitude flying is taken as a matter of course there; almost daily pilot-pupils climb their special training planes almost to 40,000 ft. Various aircraft and engines are flown at these altitudes. Lieutenant-Colonel Pezzi's flight was considered merely a "good lesson by the schoolmaster."



Here's the business end of the new record holder. The Piaggio engine is the equivalent of a typical American twin-row model.

It is a tried—and successful—Italian practice to operate special flying schools for special purposes. Besides the High Altitude School there is the High Speed School at Desenzano and the Long Distance Navigation School at Orbetello. Each has proved itself outstanding in its field. The present world speed record (440.681 m.p.h.) was made at the High Speed School. Air Marshal Italo Balbo's highly successful mass flights across the north and south Atlantic ocean were planned and organized at the Long Distance Navigation School.

Meanwhile, America's record, made June 4, 1930, by Lieut. Apollo Soucek of the U. S. Navy, still stands at 43,165.880 ft.

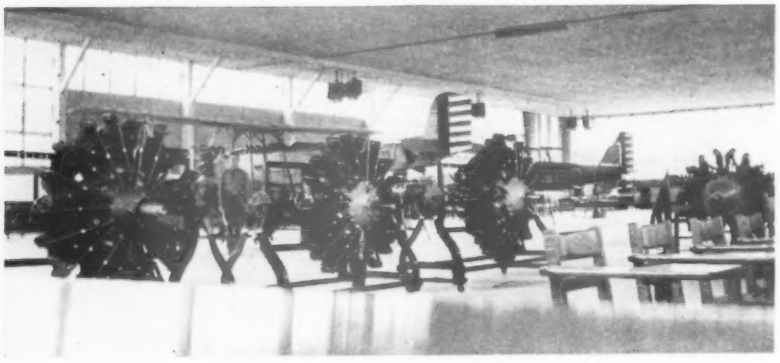
Note the large wing span and control surfaces of the Caproni biplane with which Lieutenant-Colonel Pezzi established a new world height record.

So You Want To Be

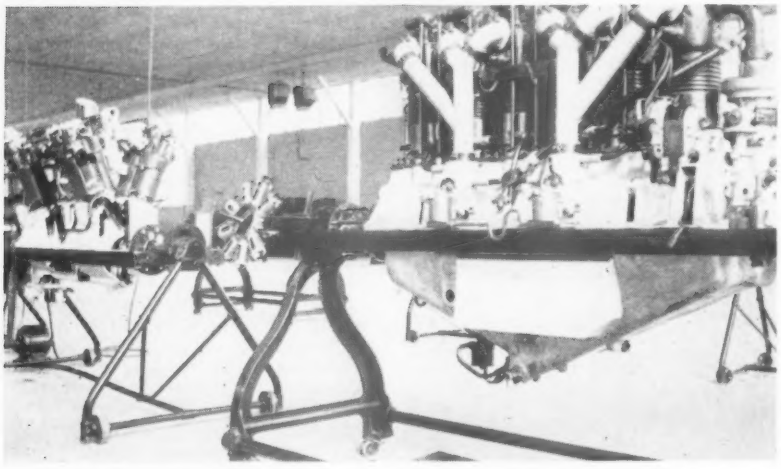
Randolph Field, Army Air Corps training base at San Antonio, Texas, is no place for a sissy. The author is, at present, a student at "Randolph-by-the-Sea". This is the first in a series of articles he will write for POPULAR AVIATION on his experiences at the far-famed aviation school.

by MAC DONALD H. HAYS

An early morning line-up of Consolidated trainers. Many a famous airman won his spurs in one of these ships.



Randolph's radial engine overhaul section.



Water-cooled engines have their own overhaul base.

IT was a nice clear afternoon the first day of March when I parked my car south of the barracks, got my suitcases out and started walking over the grass to the administration building. It was a nice day until I heard 35 upper classmen yell at me: "Well, pick 'em up, mister. We don't walk around here, we *run*."

During the next two weeks I learned that they mean what they say "in the army"; whether it was making beds or shining our brass belt buckles, everything had to be done with speed and accuracy.

The second day we all got up at 5:40 a. m., took a quick look at our roommate and ran downstairs to reveille, which lasts for 10 minutes, then back to our rooms to make our beds, shave, shine our shoes and brass and stand police inspection at 6:15. We learned that it was necessary to stand at attention, our eyes fixed on a point straight ahead during all inspections and formations. The penalty for "wandering" eyes is a trip around the ramp at full speed or cleaning up the orderly room after breakfast.

For two weeks the daylight hours were filled with six hours of intensive drill every day, uniform fitting and giving answers to such questions as this:

"What kind of an airplane is that, mister?"

"What airplane, sir?"

Or just before formal inspection at night when we would be standing at attention on the inside "stoop," our eyes fixed on the revolving beacon light at the top of the administration building.

"What does the twin beacon light mean, mister?"

"Sir, the first rotating beam means that this field is Randolph-by-the-Sea. The second means that there is a golf course attached and the place is just a big country club."

Before every drill formation we shined our shoes and our brass. During rest periods at drill some upper classman would say, "Jab!" We would hit our chests with our right fists in an imitation of pulling the rip-cord on a 'chute. He would remark: "Very poor reaction time, Mr. X., you just fell 2,000 feet before your 'chute opened."

An Air Corps Pilot?

Honor, in the flying cadet battalion, is a thing beyond reproach. Governing the student's every action, and thorough and far-reaching in its utter simplicity —it is a code which none deny or betray. The word of a flying cadet is taken without question or doubt, regardless of circumstance, and a breach of the honor code in itself spells elimination. The right thing is done, not because we are being watched, but because it is the right thing to do.

One very simple function of the honor system may be at a meal formation, every man standing at attention, and the company captain says: "Everyone who didn't shine their shoes and brass before this formation, around the ramp and when you get back bail out."

The person in the above paragraph who was told to bail out hits his chest as in a "jab," but also bends his knees and sinks to a position half-way between standing up and sitting down and holds this position with back straight and chin in. Try it yourself for about a minute and a half.

On Monday morning beginning the third week we were assigned to either "A" section for flying from 8:10 a. m., ground school from 10 to 12 noon, or "B" section with ground school first and flying second. We were a bunch of "eager misters" as we marched to the "A" or primary stage flying line located on the west side of Randolph field, "B" or advanced stage flying line being located on the opposite side of the field as far as possible from "A" stage for safety.

We met our instructors and had a talk by our flight commander, who said in part: "It may be all right to run around or walk like a ramrod—if you walk—while you are in or around the barracks, but when you get over here I want you to relax. A relaxed man can learn, a man on a tension—no."

I found that our flight was to train on the reliable PT-3A ships, powered with a 225 h.p. Wright engine, carrying 40 gallons of gasoline, and capable of standing up under the rough handling of beginners. "A" flight is equipped with Consolidated PT-11's and "C" flight with new Stearman PT-13's.

We put coveralls on over our blues, adjusted the helmet and goggles, walked to the ship with our instructor and climbed in, being careful to approach the airplaine as your would a horse—

This new arrival is getting "bailed out". That bag weighs between 50 and 60 lbs. and boy! how they make you run with it!

from the left. The speaking tube system consists of a mouthpiece and two rubber tubes running from our instructor's cockpit back to our rear cockpit and fastens to two small metal tubes sewed into the helmet. The parachute is the seatpack type so that it acts as a cushion.

After that I fastened the safety belt and the instructor took the plane off. In a few minutes he let me try the controls and it was then that I decided that the speaking tube system was unnecessary. I could hear him very clearly when he said: "You're skidding to the right, you're slipping to the left. Well, see if you can fly straight and level."

During following days we gradually became accustomed to the ship, learned how to enter and leave traffic with different wind conditions, how to negotiate gentle and medium turns without skidding and slipping—and then came the great day when we soloed.

When a man soloes he is treated with respect, given rest at formations, and in general is allowed to take the place over—for one day. King for a day. I remember my day.

An upper classman looks over a new cadet.

I made five landings by myself and thought it was great. After dinner I walked up to the post exchange, bought a box of cigars and 50 candy bars for upper classmen, as is the custom. At supper that evening the fellows who had soloed formed a line beginning at the staff table to pass out their candy and cigars. Congratulations were given and all were told to keep up the good work. Our freedom was great while it lasted. No sitting at the table, eyes on plate, knees together, saying: "Sir, please pass the meat; sir, please gun the salad." (Gun: Men at end of table raise their hands to summon a waiter. When he arrives one says: "Please gun [get some] salad.")

During our free afternoons or in the evening we learned the 16 lower class customs and a number of definitions which were to be given in the mess hall during a meal, or at any time in the barracks. An example of a definition is: "Have you had enough to eat?"

"Sir, my gastronomical satiety admonishes me that I have (not) reached that state of deglutation which is consistent with my dietetic integrity."

At the end of six weeks most of the class had soloed and many amusing incidents had occurred such as the time I asked one of the fellows if he had

Bail out, Mister!

Flying cadets live here.

gotten sick in the air and he said no, he had merely leaned over the side. But we watched him take a pail of water, go out to the ship and clean the entire side of the fuselage.

Another story is about the student who circled the field eight times on his solo flight before he gained enough courage to bring the ship down and land. The ground crew was at that moment wheeling out the biscuit gun, a device to shoot biscuits up to the student and keep him from starving to death while he made up his mind.

That biscuit gun business actually could be used, by golly. Several somewhat panicky cadets have found themselves stranded in mid-air. Then there have been many times a fellow who has already soloed gets stranded up there. One fellow was flying in a pretty heavy wind one day and each time he approached for what he thought was a normal landing he'd overshoot the field by several blocks. He just couldn't get it through his head that you're supposed to land in *opposite* direction to that the wind sock is pointing.

As to the present time, I find that flying is getting more interesting each day. Last week we had a 90 degree spot landing stage. That is, climb to 400 feet, enter traffic at one of the practice fields then cut the throttle and make a gliding turn, come in and land on a chalk mark drawn across the field. Students are graded on take-off, ability to make a rectangular course around the field, all air work, and most important of all—a good landing.

Air work so far has included chandelles, lazy eights, pylon eights, S's across a road, spins, steep banks, stalls, spirals, and one stage on 180 degree side approach spot landings.

From what little I have seen of Randolph Field, I am convinced that it is a fine character building organization for young men and can rightly be called "The West Point of the Air."

Flying Cadet MacDonald Hays, author of this article.

Here Is a Real Tire!

It's one of the two main tires that will hold up the new four-engined Douglas DC-4.

JUST what the new four-engined Douglas DC-4 will amount to in size is shown by the new tire in the accompanying photograph. Two of these tires —and one slightly smaller one on the ship's nose wheel—will be standard equipment on the new airliner which is scheduled to undergo test flights late this year.

If the size of this tire is not impressive enough, take the ship's wing spread, for instance. It is 138 ft. 3 in., larger even than the *China Clipper!* The new ship will carry 40 passengers, will have a rated top speed of 237 m.p.h. and a landing speed of 68.5 m.p.h. In addition the liner will have a cruising range of 2,200 miles, 50 miles greater than the present DC-3.

Pull 'em Nose First

HANDLING a ship on the ground may cause as much damage as in the air.

The other day a tractor hooked on to the *tail* of a large plane to haul it out of some sand. Nothing budged except the tractor and the tail, which said good-bye to the rest of the fuselage.

Planes are designed to be towed by the landing gear wheels, nose first. It's worse when a plane "lands" in the water. The tail usually sticks up.

The first thing the rescuers see is a hole through the rear of the fuselage and over it the stencilled sign "Lift Here." Which means that the hole is the proper place to run a pipe through and lift the tail up on a dolly on the ground. So some bird hooks a cable through that hole and the crane hoists away. The rest of the plane is filled with water, tons of it. The tail of the plane promptly comes away and the rest of the plane stays in the ocean.

Sound funny? Well, don't laugh too soon for this very thing has been done more than once.

FUR TAKES WING
by James Montagnes

RECENTLY a trapper, delayed at Aklavik, 200 miles north of the Arctic Circle, chartered an airplane.

He bundled into its cabin six dogs, his sled, his supplies for a winter, traps and other hardware, and then himself. He was dropped some 300 miles east along the Arctic coast in his trapping territory, within a few hours. Without the plane it would have taken him days to reach his destination, besides having to wait till winter had set in.

A couple of trappers working in the lonely region south of Coronation Gulf on the Arctic coast, where there are no Indians or Eskimos, have planes call for their furs and bring in their supplies. Nearer civilization fur posts today are accustomed to visits from planes, for prime fur is now flown out all winter while trade goods and food supplies are flown in. In northern Ontario the business is so brisk that a plane with capacity for three tons of payload is used.

Everywhere in the northland this winter planes will call at fur posts and trappers' cabins to take out the best of the fur catch. In a few years the plane has become the logical method of fur gathering. The trappers find it cheaper, because it saves them many days and weeks on the trail with the cost of food for themselves and dogs, or the cost of canoes. It has the additional advantage, according to the fur trade, of bringing a quicker turnover in cash to the trappers.

Small profits are now the rule in the fur trapping business because of the drop in fur prices. Therefore a quicker turnover on the trapper's investment has become a necessity.

The use of the airplane in the fur business has meant a longer trapping season, for now the trapper spends but a small portion of his time traveling in and out to civilization. At the same time he is able to send out more fur at more economic cost, while the safety angle is of importance to him.

Where once he had to travel by dog team and canoe, with the chances of losing some of his hard-won fur by upsets in fast flowing waters during the winter break-up of ice, today he is practically positive that his entire fur catch will arrive at the market, for airplane accidents in the north country are relatively few. Prime furs caught in season and put on the market during the season also bring better prices, so the trapper uses the plane.

The days of the leisurely fur trade are gone. The oldest business in Canada today uses the most modern methods of transportation and communication, for often planes are chartered by radio. The days of the voyagers are over, the picturesque loneliness of the trapper is fading out of the picture, and distance has been eliminated. Now that fur has taken to traveling by air, the fur business in Canada has entered a new era of marketing and trading practice.

A Movie Magnate's Racer

by ROBERT C. MORRISON

Flying is just a fascinating hobby to Amateur Hughes. This dashing young genius has spent a fortune on airplanes and has added an unique chapter to American aviation history.

SO FAR Howard Hughes has become the closest of all humans in beating the sun in its flight across the North American continent.

On a very cold morning in January, a sleek, blue and silver racer was secretly wheeled from a hangar at Union Air Terminal, Burbank, Cal. The engine was warmed up slowly and at exactly 2:14 a. m. Pacific Time, the ship splurted down the long runway and seemingly jumped into the air as it reached the border of the field.

It banked around to the east and was soon lost to sight in the darkness and smoke from California's orange grove smudge pots. Howard Hughes was at the controls and was heading for New York to establish a new transcontinental speed record—which he did in 7 hours, 28 mins. and 25 sec.!

This flight was the greatest of Howard Hughes' series of achievements. One may well remember his movie production, "Hell's Angels." Aviation enthusiasts at that time thought nothing of going to see the picture three or four times. It cost Howard a couple of million dollars to produce that picture, and just as it was about to be released the "talkies" were just becoming a realization, but "Hell's Angels" was not a "talky."

This fact endangered "Hell's Angels" success, so it was decided to start from scratch and make the film with sound costing Hughes another $2,000,000 or more. When the film was finally completed and shown to the public Hughes was minus just $4,000,000.

But there was much more where that came from. It seems that Howard's father was a very successful oil man and left him an enormous fortune, and then "Hell's Angels" brought in about $3,000,000 profit.

Howard loved aviation and first caught the "bug" when he was 14. He also had a craving for speed which seems to be the characteristic of every aviator and during the filming of his world-renowned picture there was criticism in the movie magazines on the swift technique he used in getting in and out of driveways with his car. One of his cars was a Duesenberg, but even this could not compare with the speed of an airplane, so up in the air went Hughes.

He was known all over as a rich man's son and probably has held the record for owning more planes than any other single person. Among his assortment have been a Boeing 100, Sikorsky amphibian, Beechcraft, and a Douglas DC-1. But as to his flying ability there was little popular knowledge until he was the unmistakable winner in a sportsman pilot's race in Miami several years ago. His "steed" in this race was his Boeing 100.

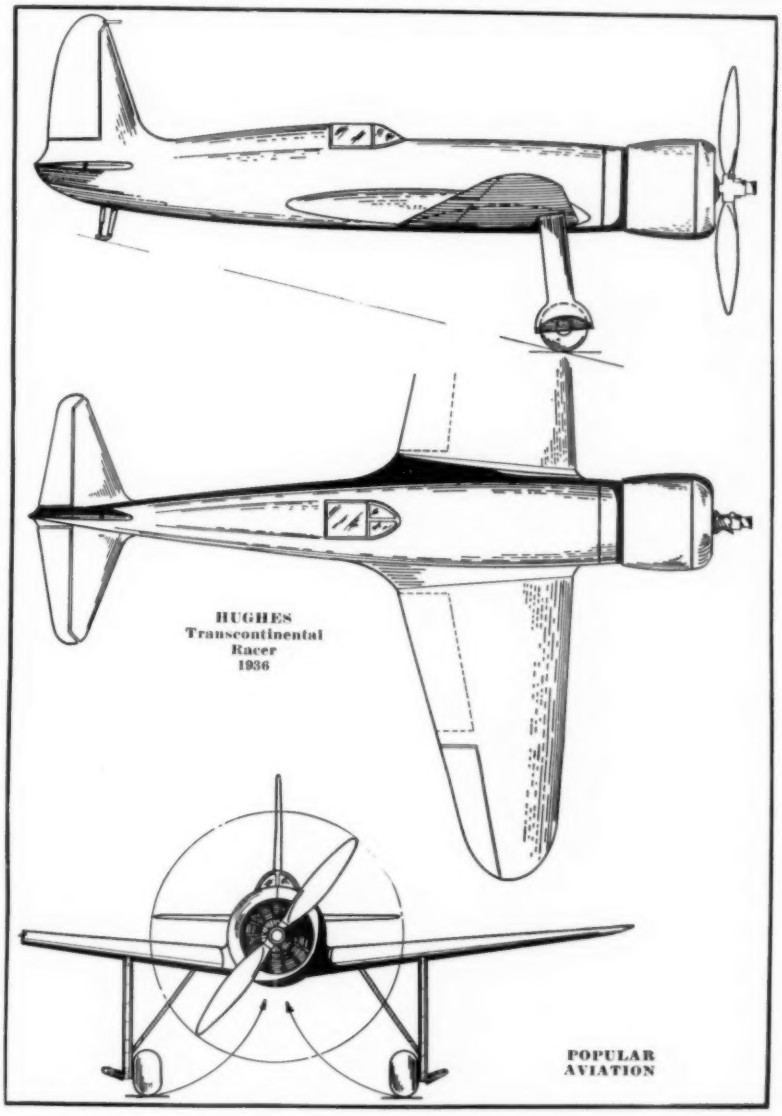
The airplane is much the same as our Army's P-12C. However, even an Army pursuit was not fast enough for Howard Hughes. He tinkered with his Boeing for some time to try and get more speed out of it.

Many a prominext airplane factory worked on it. Douglas Aircraft did about $3,000 work on it. Then Lockheed took a hand at it. At Lockheed Dick Palmer had charge of redesigning the Boeing, and finally a few more miles per hour could be pumped from the ship, and soon after Howard won his first race.

Apparently, Hughes was well satisfied with the work Dick Palmer did on his plane as Palmer is now head man in Howard's own concern, Hughes Aircraft Co. After leaving Lockheed to join Vultee, Palmer kept up his contact with Hughes, and the two of them began to lay plans for Hughes' present record breaking speed ship.

All of Hughes' exploits have been shrouded in secrecy, but the development of his racer was more so than anything else he has undertaken. It has been said however that Dick Palmer and Hughes differed as to the design of a racer. Dick thought a racing plane should be long and thin and Hughes though it should be short and fat like a Gee Bee.

To finally decide this question wind



tunnel models were made and tested in the wind tunnel at Caltech, Pasadena's noted institute. This was all done at Hughes' expense and under the supervision of W. Curtis Rockefeller, recent winner of the Sperry Award and noted meteorologist for American Airlines.

Finally, the "perfect" design was arrived at, and immediately engineers and draftsmen began the long arduous task of detailing its construction. It was to have the long slim fuselage that Dick Palmer had desired.

At that time Gerard Vultee had as a very competent chief engineer none other than Carlton Strycker who is now head of the engineering school of the Curtiss-Wright Technical Institute for Aeronautics. Carl Strycker took an interest in the plane and was given charge of the stress analysis in his spare time at night.

When a plane is designed to do 350 m.p.h. as this one was, the stress analyst has his troubles. It is said that bending moments of over 1,000,000 lbs. were encountered. Thus the structure had to be built very strong, and the wing was almost a solid mass of wood as a consequence.

The fuselage was of all-metal construction, and since the metal skin was so thick, the rivets were countersunk to make a smooth surface over the entire fuselage.

Carl Strycker promoted the idea of building a keel in the "belly" of the fuselage, and after much discussion the keel became a part of the airplane, later playing an important part in saving Howard Hughes' life, an incident which we will relate later. Though the keel had many good points such as strengthening the structure of the plane, it made the ship heavier and reduced its fuel capacity. However, various parts of the racer were stored away in the keel, such as the Sperry gyro instruments.

The remainder of the fuselage was more or less conventional in design and had in its nose a Pratt & Whitney *Twin Wasp* engine that developed about 800 h.p. normally and packed away 1,000 horses when full out.

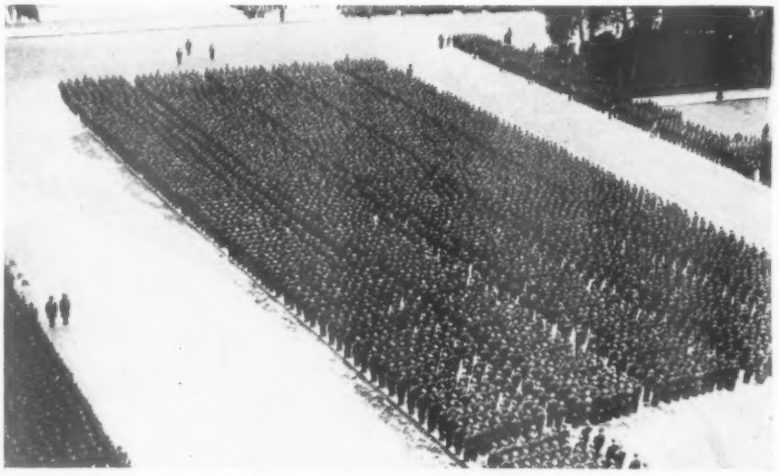
The wing was a work of art. It was of all-wood construction with a very smooth plywood covering. This covering was over an inch thick when put on and was then shaved down about a fourth of an inch to give the wing a perfect airfoil section. The plywood was then polished until it was as smooth as glass, was painted blue, and finally waxed. Two box spars were used in each wing panel, but when all the reinforcements and parts were completed to them they were practically solid spruce beams.

Two hundred eighty gallons of fuel may be carried in thre or four tanks located in the fuselage. In all the racer weighs approximately 5,000 lbs.

Hughes was naturally born an engineer. Though he did not have much school training along those lines, he has exceptional practical engineering knowledge according to men who have worked with him, and he knows every detail of his ship thoroughly. When his racer was

(*Continued on page* 64)

Just a Pilots' Get-Together!



These are Italian airmen gathered in the Piazza Venezia, Rome, during recent ceremonies celebrating the 14th anniversary of the founding of the Royal Italian Air Corps.

SOME idea of what Italy's vast air power amounts to may be gained from the above photograph. And these are just a few Italian airmen who happened to be on hand to attend the ceremonies. This group was estimated roughly at 1,300 pilots.

Today Italy ranks third in the air forces of the world. Mussolini has amassed a fleet of approximately 5,400 airplanes that are in fighting trim today. Russia's air forces still stands at the top of the list with approximately 7,500 ships while Germany has climbed to second place with approximately 6,500 airplanes. The United States is sixth among air powers, having dropped one place when Germany climbed to second place. This country's total military air equipment is said to be approximately 2,100 ships.

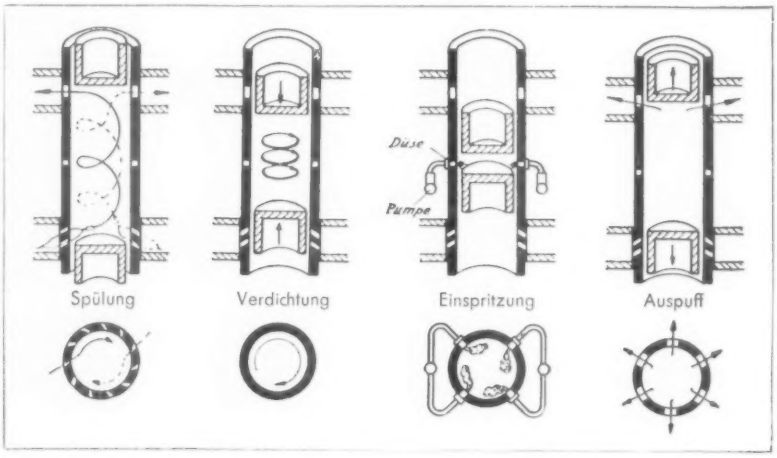
The Operating Cycle of the Junkers Diesel

by AUGUST BUSCH

SO many readers have requested information regarding the operation of the Junkers Diesel engine that we are reproducing (below) the diagrams recently published by the Junkers company.

The longitudal sections taken through the cylinder at the top of the diagram show the piston positions during the periods of scavenging and intake movement at the (Spulung): During compression (Verdichtung): Ignition (Einspritzung): and exhaust (Auspuff).

The movements (apart) of the two pistons first scavenges out the burned gases from the first explosion and provides fresh air (Spulung). Then the pistons move toward each other on compression: Verdichtung: Then injection and ignition (Einspritzung). At the end of the stroke, with the pistons far apart we have the exhaust (Auspuff).



The NATIONAL AIR BOARD *Says*—*Unbiased Opinion to Further National Aeronautics*

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ALEXANDER KLEMIN, CHAIRMAN

AT the 13th meeting of the Air Board, 13 members were present. But there were no untoward events because of the "unlucky" number and no one collapsed after eating his lunch. As is now traditional, a number of distinguished guests were present including Leonard Outhwaite who, in collaboration with C. T. Ludington (a member), is doing so much for the Aviation Museum of the Franklin Institute; Jerome Lederer, chief engineer of Aero Insurance Underwriters, well known exponent of the cause of aviation safety; and J. B. Bartow and S. Lewis Ziegler, Jr., who, at the end of the meeting, gave an interesting demonstration of the Bartow controlled airport lighting system.

1. THE BAN ON THE TRANS-ATLANTIC AIR RACE

When Dr. J. H. Kimball, the famous head of the New York weather bureau, made his bold speech pointing out the dangers of the trans-Atlantic air race, he started a strong wave of protest. Now the Department of Commerce has forbidden departure of aircraft from United States soil and the race will in all probability never be held. Strictly speaking, the Department has no legal authority to forbid such races, but it can withhold the N. R. license and make things very uncomfortable for anyone participat ng—as Ray Quick told us.

Animated discussion led to the general conclusion that such adverse action was fully warranted. But some real arguments in favor of this and similar races were set forth and merit placing on the record:

Mr. Outhwaite thought it would be a terrible pity if all adventure were taken out of the air. One of the reasons people travel by air is that they thereby feel themselves participants in adventure, and a trifle superior to the commonplace travelers on the rail. No game is worth the candle, said Mr. Outhwaite (an ardent yachtsman) unless it has some element of risk. Since the external cry of modern civilization is for safety, it is at least refreshing to remember that danger has its own especial charm. And Mr. Ludington's reference to the Indianapolis automobile races emphasized this point of view.

But it was Casey Jones who in his own inimitable fashion made the most spirited attack. After all, races brought business to the manufacturers and induced progress in equipment and orders for some four million dollars of equipment were now cancelled. And even if several aircraft went down in the Atlantic this would in no way reflect on Pan American Airways operations. Still it was not with the ban on this particular race that Mr. Jones was concerned. What seemed to him indefensible was the inconsistency of the Air Commerce Bureau, while Merrill's flight to the coronation and back, and Amelia Earhart's somewhat purposeless jaunt around the world were regarded with favor.

Though Captain Depew forcefully pointed out that in the trans-Atlantic race contestants would have to take the weather more or less as it came while Miss Earhart could pick and choose her departures, the Board felt that inconsistency there was:

If races across the Atlantic are to be forbidden, then like action should be applied to other similar adventurous efforts serving little purpose but the creation of excitement and the gaining of temporary glory.

Howard Hughes (left; also see page 45) confers with Grover Whalen, director of the coming New York World's Fair and member National Air Board. Hughes was recently appointed an advisor to the 1939 event for which New York is already preening herself.

2. CONGRATULATIONS TO LIEUT. RICHARD ALDWORTH

On Saturday, June 5th at Mitchell Field, Long Island, an Air Board member, Lieut. Richard Aldworth was decorated with the Distinguished Flying Cross. An imposing ground and aerial review marked the event.

On a motion of Augustus Post, unanimously carried, the Air Board extended its heartiest congratulations to Lieutenant Aldworth, who was responsible for bringing down seven or eight German airplanes during the World War. It is not amiss to remember from time to time what splendid fighting service our modest flyers rendered during the war. Nor will men of equal caliber be wanting in the United States should it ever be forced into the mishap of another great war.

3. SHOULD HELIUM BE SOLD TO GERMAN AIRSHIP INTERESTS?

Mr. Wilford introduced this timely

topic recalling the arduous process of helium manufacture. When the natural gas containing seven to nine percent of helium is treated, there is no chemical ingenuity that can trap this most inert gas, valuable because of this inertness. There is nothing to be done but to freeze huge masses of mixed gases, till the almost unfreezable helium remains. When the costs of transportation of liquid helium via tank car are taken into account, it is no wonder that $6 per 1,000 cubit feet seems to be the irreducible minimum.

In some quarters the United States government has been blamed for refusing to sell helium to Germany and thus being indirectly responsible for the *Hindenburg* disaster. "Nothing to it," said W. C. Young, who should know the situation if any one does. Ten years ago, the Goodyear-Zeppelin Corporation and the former Helium Corporation of America could have readily secured permission to sell helium to Germans but they refused on two grounds. First, because Dr. Eckener did not consider hydrogen a hazard; second, because helium with its lesser lift meant serious loss of payload.

However, that is past history. What is more important now is whether regulations for sale of this gas to Europeans should be favorably completed today. The argument against the granting of such privileges is a military one. Why should we release helium and make foreign airships more feasible in operation, when such airships might conceivably be used some day to attack New York City? Mr. Young set forth the following paradoxical argument. Selling helium to foreign interests would actually be a defensive measure! Once addicted to this gas European interests, if they became hostile, would actually be incapable of operating with hydrogen when their carefully rationed supplies of helium were suddenly cut off. And certainly humanity would urge us to make the precious gas available to all in need of it.

On the strength of these reasonable pleas, the Air Board recommended (frowning, however, on the idea that our sole remuneration should be in the form of expert service)

> "That helium should be provided to foreign interests carrying on bona-fide commercial operation; in carefully rationed quantities adequate for such operation but not large enough to provide military reserve; that all other military precautions should be observed; and and that sale of helium should be strictly on a cash basis."

4. METAL-CLAD V. RUBBER COVERED AIRSHIPS

Let us assure our readers that the deliberations of the Board are conducted in the friendliest manner, though informally. This does not preclude warm controversy at times. As was the case when Mr. Wilford urged that even the large 5,000,000 cubic foot airships should be of the metal-clad variety, and Mr. Young took the opposite position.

(*Continued on page 57*)

Can the Rotor Plane Be Perfected?

by LYNN C. THOMAS

This weird contraption startled many an airport-goer just a few years ago. Experimental rotor planes have flown but their stability is so negligible as to make them dangerous.

SINCE 1903 when the Wright brothers astounded the world by making the first successful flight in a heavier-than-air machine, many men have died in the effort to further develop the stability, speed, power and lift of the modern airplane. Many have also given their lives in the unsuccessful attempts to produce an airplane that will rise and descend vertically.

The helicopter, which gained such prominence a few years ago, does not show any promise of being the answer to this problem. The autogiro, an adaption of the helicopter principle is the closest type yet that has shown any promise. They have been developed so that they can take off at about a 45 degree angle and land at an angle of 80 degrees.

Before one can speculate on the feasibility of the Magnus principle, it is necessary to look into the history of its application in other fields.

In 1853, Heinrich Gustave Magnus, a distinguished German chemist and physicist, first described his theory, which has since been universally known as the Magnus Theory.

From Professor Magnus' discovery it was learned that, if a current of air is directed against a smoothly polished revolving cylinder, whose circumferential speed is greater than that of the air current, a force is directed against one side of the cylinder.

The explanation is simple. The layer of air next to the cylinder revolves with the cylinder, for the reason that the friction between this stratum of air and the cylinder is greater than the friction of air molecules against each other.

This rapid whirling of air currents with the movement of the cylinders produces a partial vacuum on one side of the cylinder and compresses the air on the other side. This variance of air pressure, which will be practically constant if all factors remain constant, is the explanation of the Magnus Effect, which as will be readily seen, exerts a force on the cylinder directly toward the areas of rarified air and directly away from the opposite field of highly compressed air.

Several types of rotor planes have been developed in the past few years; and these, always allowing for minor variations, seem to exhaust the possibilities.

One of these types of rotor planes employs wings of ordinary design, though shortened to about one-half of the average length. In this design, outrigged rotors, somewhat shorter than the wings are employed as extensions to the wings.

The proponents of rotor airplanes, employing the Magnus Effect, make many claims for this type of plane. They contend that a rotor plane will afford approximately ten times the lift of the standard airplane of the same size and weight. They also claim that with this increased lift, a rotor plane will carry many times the load of a wing plane of the same size and weight. They do not promise a vertical ascent or descent as the pull of the propeller precludes this, but they do maintain that a rotor plane will make possible a more abrupt take off and landing than an autogiro.

The difficulty of gliding a rotor plane to earth in case of a stalled motor has been one of the chief arguments against this type of plane. The doubters also point to the fact that the sustaining surfaces of a rotor plane must be convex, indicating a greater air leakage than must be contended with when gliding on the conclave surfaces of the average type of wing.

One of the latest developments of the Magnus principle can be briefly described. It is composed of a normal airplane wing, the wing section is of course modified so that the rotor may operate with the most efficiency, also the upper wing surface in the rear of the leading edge is concave instead of convex so that the rotor is free to spin

(*Continued on page 63*)

Elements of Airplane Design

by RAOUL J. HOFFMAN

This is the first of a series of articles on the design calculations entering into lightplane design. The methods are very simple and extremely brief, requiring no technical knowledge.

DESIGNING an airplane or any other engineering unit is based on empirical or scientific data derived from tests of full-sized airplanes or reduced scale models in co-ordination with some workable theories. Most data are carefully guarded by each individual designer and especially by the manufacturers, for most designs depend on the location of the plant, the number of units and the previously built planes.

To simplify the method of preliminary designing and to have a fair degree of accuracy, the design must follow along conventional lines with only minor aerodynamic and structural improvements. The estimate should ascertain the general dimensions and performance expected of an airplane carrying a number of passengers with an engine of known output, as well as the approximate gross weight.

The gross weight, a decisive factor, may be estimated if 550 lb. are taken for the pilot, 500 lb. for each passenger or co-pilot, 4.75 lb. for each horsepower of the engine, and 1½ times the weight of cargo or the weight of special equipment.

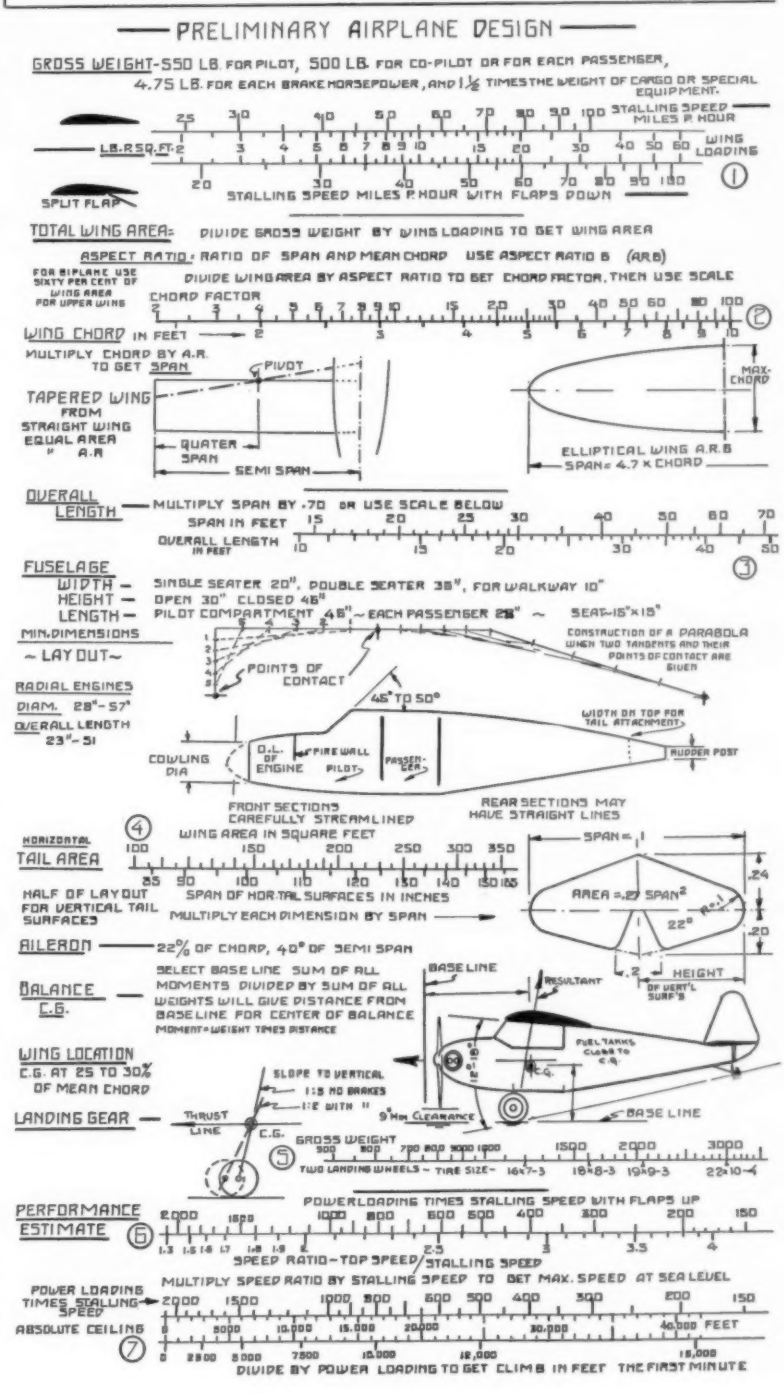
Another factor dominating the airplane design is the stalling speed (often called the landing speed) which is the lowest speed possible with a certain wing loading and a certain wing section. For estimating purposes a medium thick wing (12 to 13 per cent) is used, which will give the stalling speeds indicated on scale No. 1. For wings with flaps the lower graduation is used. Usually the stalling speed is assumed and the wing loading found; then the total weight is divided by the wing loading and thus the wing area obtained.

The area of a rectangular wing is equal to the span times the chord, which makes it possible to have a multitude of plan forms. The ratio of span to chord is called the aspect ratio (A.R.) usually from 5 to 8, with an average of 6. Dividing the area by the aspect ratio the chord factor is obtained. Then the chord may be found by using scale No. 2. Multiplying the chord by the aspect ratio the span is determined.

In case a biplane is designed, about 60 per cent of the total area is used to estimate the dimensions of the upper wing.

Having found the span and the chord, a rectangular wing may be laid out. In case a tapered wing is wanted of the same aspect ratio and area, the leading or trailing edge may be rotated about a point located at quarter span. A taper of 2 to 1 will be as good as any curved plan form. The often-mentioned elliptical plan form is too pointed for small

Here Are a Few Airplane Design Factors


PRELIMINARY AIRPLANE DESIGN
GROSS WEIGHT-550 LB. FOR PILOT, 500 LB. FOR CO-PILOT OR FOR EACH PASSENGER, 4.75 LB. FOR EACH BRAKE HORSEPOWER, AND 1½ TIMES THE WEIGHT OF CARGO OR SPECIAL EQUIPMENT.
STALLING SPEED MILES P. HOUR
WING LOADING
LB. P. SQ. FT.
STALLING SPEED MILES P. HOUR WITH FLAPS DOWN
SPLIT FLAP
TOTAL WING AREA: DIVIDE GROSS WEIGHT BY WING LOADING TO GET WING AREA
ASPECT RATIO: RATIO OF SPAN AND MEAN CHORD USE ASPECT RATIO 6 (A.R.6)
FOR BIPLANE USE SIXTY PER CENT OF WING AREA FOR UPPER WING
DIVIDE WING AREA BY ASPECT RATIO TO GET CHORD FACTOR, THEN USE SCALE
CHORD FACTOR
WING CHORD IN FEET
MULTIPLY CHORD BY A.R. TO GET SPAN
TAPERED WING FROM STRAIGHT WING EQUAL AREA " A.R
PIVOT
QUARTER SPAN
SEMI SPAN
MAX. CHORD
ELLIPTICAL WING A.R.6
SPAN = 4.7 × CHORD
OVERALL LENGTH
MULTIPLY SPAN BY .70 OR USE SCALE BELOW
SPAN IN FEET
OVERALL LENGTH IN FEET
FUSELAGE
WIDTH — SINGLE SEATER 20", DOUBLE SEATER 38", FOR WALKWAY 10"
HEIGHT — OPEN 30" CLOSED 46"
LENGTH — PILOT COMPARTMENT 48" — EACH PASSENGER 28" — SEAT-15"×15"
MIN. DIMENSIONS — LAY OUT —
RADIAL ENGINES DIAM. 28"-57" OVERALL LENGTH 23"-51
POINTS OF CONTACT
CONSTRUCTION OF A PARABOLA WHEN TWO TANGENTS AND THEIR POINTS OF CONTACT ARE GIVEN
45° TO 50°
WIDTH OR TOP FOR TAIL ATTACHMENT
RUDDER POST
COWLING DIA
C.L. OF ENGINE
FIRE WALL
PILOT
PASSENGER
FRONT SECTIONS CAREFULLY STREAMLINED
REAR SECTIONS MAY HAVE STRAIGHT LINES
HORIZONTAL TAIL AREA
WING AREA IN SQUARE FEET
HALF OF LAY OUT FOR VERTICAL TAIL SURFACES
SPAN OF HOR. TAIL SURFACES IN INCHES
MULTIPLY EACH DIMENSION BY SPAN
SPAN = 1
AREA = .27 SPAN²
22°
.24
.20
.2 HEIGHT OF VERT'L SURF'S
AILERON — 22% OF CHORD, 40° OF SEMI SPAN
BALANCE C.G. — SELECT BASE LINE SUM OF ALL MOMENTS DIVIDED BY SUM OF ALL WEIGHTS WILL GIVE DISTANCE FROM BASE LINE FOR CENTER OF BALANCE
MOMENT = WEIGHT TIMES DISTANCE
BASE LINE
RESULTANT
WING LOCATION C.G. AT 25 TO 30% OF MEAN CHORD
FUEL TANKS CLOSE TO C.G.
LANDING GEAR
SLOPE TO VERTICAL
1:5 NO BRAKES
1:2 WITH "
9" MIN. CLEARANCE
THRUST LINE
C.G.
GROSS WEIGHT
TWO LANDING WHEELS — TIRE SIZE — 16×7-3 18×8-3 19×9-3 22×10-4
PERFORMANCE ESTIMATE
POWER LOADING TIMES STALLING SPEED WITH FLAPS UP
SPEED RATIO — TOP SPEED / STALLING SPEED
MULTIPLY SPEED RATIO BY STALLING SPEED TO GET MAX. SPEED AT SEA LEVEL
POWER LOADING TIMES STALLING SPEED
ABSOLUTE CEILING
FEET
DIVIDE BY POWER LOADING TO GET CLIMB IN FEET THE FIRST MINUTE

areas and a plan form of parabolic curves should greatly improve the performance.

The overall length of an airplane may be made a function of the span; a 70 percent ratio would make a good average which is used on scale No. 3 to determine the overall length.

The next item in design is the fuselage. Using the minimum dimensions required for the pilot's compartment and for the spacing of the passenger seats, a general outline may be made with a maximum thickness at 33 per cent of its length. Other dimensions to be considered are the diameter of the cowling, the overall length of the engine (including the engine mount), the fastening of the rudder post, the space for the tail skid and the ample distance between the fastening bolts for the tail surfaces.

The area of the horizontal tail surfaces should be at least 13 per cent and for the vertical surfaces at least 6½ per cent of the wing area. Scale No. 4 gives the span in inches of the tail surfaces (13 per cent) if all dimensions of the sketch are multiplied by it. Use half of the outline for the vertical tail surfaces.

For aileron dimensions 25 per cent of the mean chord and 40 per cent of the semi-span should be used.

A very exacting job should be done in estimating the center of balance or the center of gravity (C.G.). Ninety per cent of all failures may be traced to the wrong position of the C.G. in experimental planes.

The C.G. should be determined for vertical and horizontal location. Assuming a horizontal and vertical base line adding all moments (weight times distance) and dividing this sum by the total weights in question the distance from the respective base line is found. The C.G. should locate at 25 percent to 33 percent of the mean aerodynamic chord and just below the thrust line of the propeller.

The location of the landing gear must be in a certain relative position to the C.G. in order to prevent nosing over. It was found that with a horizontal thrust line, the line passing through the center of gravity of the plane and the axle should have a slope to the vertical not less than 1 to 5 if no brakes are used and a slope of 1 to 2 if brakes are used.

Another point to be considered for correct location of the landing wheels is the angle the chord line has with the ground line in order to enable a three-point landing. This angle is from 12 to 18 degrees.

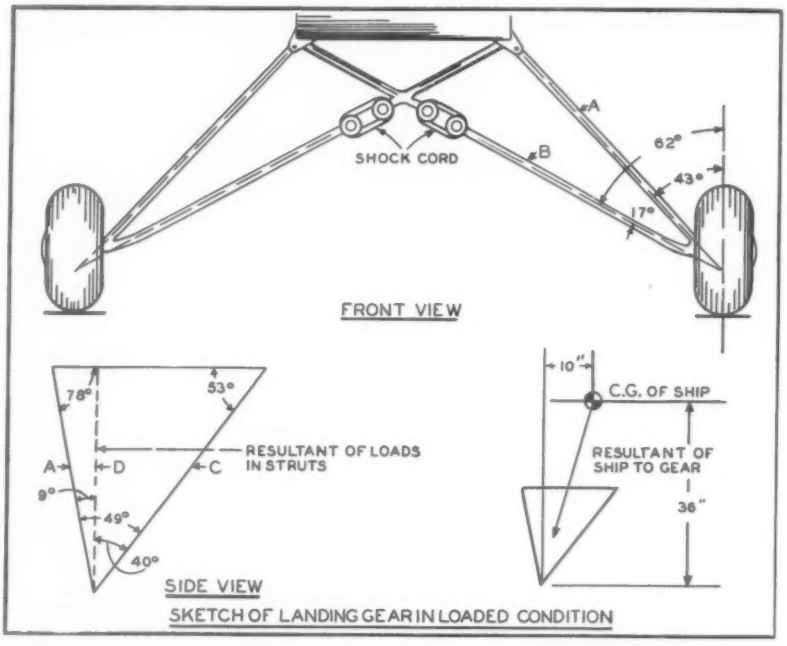
Having determined most of the dimensions of the airplane, the main performance figures may be approximated with the aid of scales No. 6 and No. 7. An illustrative example will show their use.

An airplane carrying one pilot and one passenger is powered by a 70 h.p. engine. The estimated gross weight is 1382 lb. An assumed landing speed of 40 m.p.h. (with flaps down) will require a wing loading of 9 lb./sq. ft. With flaps up the stalling speed will be 52 m.p.h. (Scale No. 1.). The total wing area of

(*Continued on page* 61)

Landing Gear Stresses

by CONRAD J. MORGAN



SKETCH OF LANDING GEAR IN LOADED CONDITION

THE first step in running the stress analysis of the landing gear is to find the load factors required and the height of the free drop in inches.

By the Department of Commerce Bulletin 7-A, the factors are found as follows: level landing for airplanes of over one-thousand pounds gross weight, $n = 2.80 + \frac{9{,}000}{W + 4{,}000}$, where W is the gross weight of the ship in pounds.

For airplanes of less than one-thousand pounds gross weight, $n = 3.00 + 0.133\ s$, where s is the wing loading per square foot. The factor need not exceed 4.33 in either case. Three point landing shall be the same as level landing.

Side-load landing introduces a new force. An applied load equal to the gross weight of the airplane (less landing gear) times one-tenth of the level landing load factor shall be assumed to act inward at the point of contact on one wheel with the ground in a plane normal to the plane of symmetry.

The height of free drop in inches shall be 0.36 times the calculated stalling speed in miles-per-hour. Need not be more than 18 inches for conventional airplanes.

Now let's analyze the landing-gear in the level landing condition of a hypothetical airplane of 800 lbs. gross weight and a stalling speed of 40 m.p.h. It has 140 sq. ft. of wing area, a wing loading of 5.48 pounds per square foot. The landing gear weighs 50 pounds.

A drawing of the landing gear is shown in the above figure; it is drawn in the loaded condition.

Level landing load factor is: $n = 3.00 + 0.133 \times 5.48 = 3.73$.

Three-point landing is also 3.73.

Side landing, the applied load is: $.10 \times 3.73 \times 750 = 280$ pounds.

Height of free drop: $0.36 \times 40 = 14.4$ inches.

In measuring the angles between the struts it is necessary that the landing gear is in the loaded condition, with the shock absorbers in the full extended condition, for it is this condition we are interested in as the loads are much greater when the gear is compressed.

Then in the level landing condition the load on the gear is: $3.73 \times 750 = 2{,}800$ pounds. This is divided between the two wheels so that each wheel takes $2{,}800/2 = 1{,}400$ pounds. This is applied at the center-line of the wheel. One side only need be analyzed.

Then to find the load in the side struts, A on the drawing. This is the load in both of these struts and is called the resultant of their loads, it will be broken down into its individual loads later.

Then: $\frac{1}{\sin 19^\circ} \times \sin (180^\circ - 62^\circ) \times 1400 =$

$\frac{1}{.3256} \times .8829 \times 1400 = 3{,}800$ pounds.

The load in the shock strut B, is: $\frac{1}{\sin 19^\circ} \times \sin 43^\circ \times 1400 = \frac{1}{.3256} \times .6820 \times 1400 = 2{,}920$ pounds.

(*Continued on page* 68)

Parachute Jumpers Are Funny

by DAVE GOLD

Here is what a parachute jumper looks like to an air-minded groundling. And a fellow who's helped these leaping umbrellamen with many an unruly 'chute ought to have a good slant on them.

I CAN now well understand the mental agony that Napoleon went through during his exile. I too, in my young years, am destined to a life of living with me, myself, and I. To the bargain, I find myself becoming slightly neurotic due to self pity.

The causes of my degradation are my selfish, so called sense of humor, and a few near-disastrous parachute jumps. I have the misfortune of belonging to that class of people which laughs at the wrong time and wrong situation.

The goofy antics of the movie comedians will draw a giggle out of me. But, let there appear a person in front of me, and let that said person execute a pancake landing on the icy pavement. The worse the landing, the more lusty my laughter. So, dear reader, you can easily imagine that I'm not the kind of person that is wanted around.

Being interested in parachutes, it was quite natural for me to befriend the 'chute jumper at our local airport. After a while, I was given the important task of helping to pass the "hat" (a tin can) around. However, it was after each jump that my most liked jobs began.

These were to run after the jumper and help him collapse the parachute when he landed, and, with a lot of self-importance, carefully roll up the 'chute. Everything went along smoothly for a few weeks, and I became more proficient in my little tasks.

One Sunday the jumper arrived with a sore ankle. Rather than disappoint the dusty crowd (it took only 15 minutes for a person to get a layer of dust behind the ears and under the eyes at the airport) he decided to go ahead with the jump. However, to enable an easier landing, he planned to open both parachutes on the way down.

It was a queer day. Mr. Wind, though not blowing fast, was a bit tricky, and kept blowing dust and paper around in small whirlpools. Nevertheless the anticipated jump went through as scheduled.

Soon I was trotting along trying to gauge where the jumper would land. There he was overhead, occasionally slipping his 'chute. My face was a mask of seriousness. About 700 feet from the ground, the jumper started to open his reserve 'chute. This is done by feeding the parachute to the air by hand, after the rip cord has been pulled.

The canopy was well out of the pack, and starting to billow out in front of the jumper. It was then that Mr. Wind got in his dirty work. The reserve 'chute took a course around the back of the jumper, and headed right into the open parachute overhead. A bad entanglement was very probable.

With amazing rapidity, the slightly worried 'chutist started to pull in the reserve canopy. He soon had the entire canopy piled in his hands. It was impossible for him to see where he was headed, because his chest and face were covered by the silk mass.

I felt myself starting to chuckle at the awkward looking figure at the end of the parachute's shroud lines. However, I controlled myself, as everyone else was deadly quiet after seeing the narrow escape.

The jumper neared the ground, and right in front of my eyes, I was nearby, he landed. He hit like a sack of flour carelessly thrown off a truck. Landing on his heels, he rolled onto his back, and ended by doing a brief, vertical stand on the back of his neck.

The author hard at his favorite profession.

My self-control was poor. I burst out in an uncontrollable fit of laughter. The jumper looked up from his sitting position on the ground with a look of surprise and murder combined. As soon as my bit of hilarious hilarity was over, I solemnly rolled up the 'chute.

My next show of my preverted sense of humor was soon to follow. Like all parachute jumpers, my friend had a little invention of his own. His prize masterpiece was a specially constructed pair of rubbers. These fitted right over the sneakers that he wore, and helped to absorb his landing shock.

One day, forgetting to bring his sneakers, he decided to wear the "shock absorbers" right over his regular oxford shoes. This later proved to be his undoing.

Out in the center of the field, I stood and watched the jump with a tension that I've always experienced at the sight. A brief free-fall, a flash of silk in the dying sun, and the 'chute was open.

Two specks falling from the jumper caught my attention. Probably his helmet and goggles, thought I to myself.

I soon discovered that I was greatly mistaken. As he floated lower, I noticed that instead of rubbers projecting from his pant's cuffs, a pair of stockinged feet were in their place.

In a flash it dawned on me as to what had happened. The opening shock of the parachute had flipped off his complete footgear, just as easily as you would your night slippers with a smart kick.

Fortunately his descent was slow due to the calm nature of the wind that day. Unfortunately, he was headed for the worse part of the field, which was strewn with small, jutting rocks. Landing on that stuff was worse for a jumper's feet than solid concrete.

I ran to the spot at which I thought he would alight. He came in, but thanks to his slow descent, he was able to make a standing-up landing. With his face a picture of every pain imaginable, he started to hop around like a crazed kangaroo doing a version of an Indian war dance. The sight was too much for my inverse sense of humor.

With my head back, and salty tears rolling past my dusty cheeks, I laughed This time the jumper looked at me with murder in his eyes, the look of surprise not there as before, and very conspicuous by its absence.

However, the straw that broke the camel's back, and almost my neck, came a few weeks later. The jumper arrived all decked out in a new pair of coveralls. My heart skipped a beat in anticipation, as he told me of his intention to do a long delayed drop, as the crowd, and the collection, looked good.

With a tinge of impatience, I watched the plane carrying the jumper take off. It ascended in a slow circle. Finally reaching the desired altitude, it headed across the field. With its engine cut, it slowly glided. I could see a speck getting on to the wing walk.

As the plane flew across the sunset sky, a figure detached itself. Down the figure hurtled at the mercy of gravity, with a neatly folded 24 foot disk of silk to soon fight its pull.

My eyes were glued onto the rapidly tumbling body. Bad business this tumbling. Nearer the earth he fell, no longer a speck, but a visible man's body. I expected to see a mushroom spread over the figure at any moment.

The falling jumper pulled the rip cord. What was enacted before my eyes the next few fleeting moments, I have no desire to see again. The pilot 'chute jumped out, but due to the tumbling action of his body, the little 'chute momentarily caught on his neck. But the damage was done. Before the pilot

'chute was quite clear again, the silk canopy wound itself 'round the jumper.

All we on the ground could see was his hurtling body, with the silk folds flapping around him. I felt sick. I was entirely void of any desire to laugh, or even grin.

I watched the struggling figure trying to loosen the folds of the parachute that seemed destined to be his burial shroud. This time running, not trotting, I arrived near the spot where it seemed his body would hit.

Up in the air the jumper worked fast and cunningly. He succeeded in loosening the entwining folds. With one hand he found the rip cord of his reserve 'chute and pulled it. With the other he then grabbed the reserve canopy and gave as much of it as possible a push between his legs. This was the only free place.

We on the ground saw another white canopy shoot away from the doomed man and pop open. I stood transfixed at the change in events. About 450 feet separated the saved parchutist and the hard ground. The main 'chute in the meantime had entirely loosened, and, to our amazement, was starting to open also. It hadn't quite filled, when with a "splat", the unlucky 'chutist landed in a small mud pond, and fell over on to his hands. The 'chutes, relieved of their load, spilled air and fell forward, luckily, on dry land.

He was a sight to behold as he walked out of the mud, disgustedly shaking off the mud with downward, jerking motions of his arms.

When my eyes fell on his once new coveralls with the mud from elbow to arm and foot to knee, I felt a ticklish sensation. Once more my laughter rang over the field.

I can thank the fact that the jumper was busy answering the questions of the rapidly accumulating mechanics. This alone saved me the trouble of going around with a plaster cast around my neck.

No, I don't go out to the airport anymore. It's in self defense. Every time I want to go, I picture the jumper getting hurt in a *funny* way. You see, I've heard of people dying from laughing too heartedly. After all I'm young, and besides I love life.

END

Windy? Open Hangar Doors!

WHEN the wind starts blowing wind-socks out straight and the trees creak and bend, *don't* obey that first impulse to shut your hangar doors tight. Instead, open them a little!

Engineers of the Aero Insurance Underwriters warn hangar-owners and airport operators to open hangar doors about 18 inches during violent windstorms. Reason for this, the engineers say, is to permit the pressure inside and outside the hangar to equalize.

This reduces the danger of having the hangar suddenly collapse and also lowers the fire hazard which results usually from the suction of gas out of airplane gas tank vents by the negative pressure.

What One Woman Thinks
by ANONYMOUS

WHEN my searching eye fell upon Swanee Taylor's "Clear and Unlimited" commentations, in the March issue of POPULAR AVIATION, I noted the sentence, "In fact, the only sin of commission I can't abide is a selfish, underhanded abuse of our beloved aviation".

I was unusually impressed. I had discovered a new friend! Not only that, but I was thrilled to the quick to learn that Eastern Airlines had replaced hostesses with stewards. However, that "women are so much smarter than men—on the ground" stuff was the direct cause of my insomnia last night.

Because Mr. Taylor himself stated "And whereas it's plain fare, folks, it's mighty good for insomnia resulting from troubled conscience", I concluded that the only way to prevent the possible recurrence or continuation of last night's insomnia is to dish out a bit of plain fare myself today. So here goes!

I honestly believe that removing hostesses from airlines is a great step forward. Aside from other reasons, the psychological effect on pilots alone warrants their removal. Of course pilots resent being insulted with hostesses. I don't blame them!

In my opinion, it is of vital importance to protect pilots from just cause for great anguish of mind. Everything possible should be done to keep them in a serene mood so that they can give their best attention to the difficult feat of flying. But there are other phases to be considered. Hostesses are required to be nurses, and everyone knows that nurses are trained to administer to the needs of the sick. I suppose that explains the fundamental purpose of their presence in airplanes. Herein, however, lies the fallacy of their purported value to passengers.

Being a nurse of a sort myself, I cannot help but mention that when a patient in a hospital becomes violent, male assistants are called to the rescue for the twofold purpose of restraining the patient and protecting the nurse from physical harm.

Ordinarily, the weights of such men exceed the weight of the nurse by 20 or 40 pounds. Hence, one such person could do more restraining and protecting in one minute than several nurses could in two minutes. Time also, I believe, is an important factor in aviation.

Further, I have never seen any of these male assistants develop hysterics, but I have seen many hysterical nurses and have often been that way myself, both on the ground and in the air.

Let us assume that, due to bad weather, it is necessary to climb to a high altitude and that such altitude (or the very presence of the hostess) physically affects a passenger in such manner that he acts like a madman and threatens to endanger the life of the hostess.

What will she do? Will she ring for the pilot or copilot to leave the cockpit and hastily come to her rescue at a time when the fate of everyone in the plane depends upon the pilot and copilot devoting their undivided attention to the task of flying safely through a storm?

Miss Earhart, foremost of women pilots, has expressed views similar to those of the author of this article.

On a recent trip when this incident occurred, these words ran through my mind: "Stifle them! When a nation's life is at hazard, we've no time to think of men!", and I ardently hoped that the copilot would shout them at the top of his voice.

However, being a courteous and polite young man (as well as very handsome), he refrained from voicing any opinion on the subject, and while I do not pretend to be a mind reader or have any psychic power akin to that, I shall never be convinced that if the mind of that gentleman were read right then and there his thoughts would not be adequately described as deep dark brown in color.

After the copilot had returned to his cockpit and closed the door behind him (thereby narrowly avoiding the catastrophe of my becoming hysterical, as the one thing that throws my mind off balance is to have a pilot who knows what to do with those jiggers and knobs involuntarily leave his cockpit), I ventured to look about me.

The elderly man in the seat across the aisle from mine winked mischievously and shook his head in a sadly derogatory manner. Because of my inability to wink, I could not return his mutually sympathetic gesture in any way other than to gravely shake my head and emit a sigh. That is exactly what I did.

Is it fair to the pilots and passengers to cause either of the pilots to leave his cockpit when an airplane is in flight, especially to protect a woman who is not even a fare-paying passenger?

In a situation of this sort, a quick-thinking, quick-acting 150-pound flight

(*Concluded on page 67*)

Our Readers' Gas Models

Model airplanes powered with miniature gasoline engines have attracted thousands of young and old until today the gas model business is zooming to sensational heights as a "Great American Hobby."

BUILDING gasoline engines for model airplanes is probably the biggest "model" business in the United States today. The assembly plant of at least one company presents an appearance not unlike that of a modern automobile manufacturer. In other words, the gasoline-engine-powered model airplane has arrived with a bang much louder than that of the engine's single cylinder.

While there have been a few murmurs against the high-flying models, the gas model by and large has "caught on" like very few hobbies ever have. Gas model clubs have sprung up from coast to coast. The "powerful" (usually 1/5 h.p.) model engines have expanded the model airplane field to the point where, today, models with 12 foot wing spreads are not unknown. As one pilot put it recently: "It's pretty hard to tell nowadays where the gas model ends and the lightplane category begins." One model shown in the accompanying photographs has a nine-foot span. It was built by John Pond of San Francisco.

Pond's model (he has named it *Cavalier*), despite its size weighs but 4½ pounds. It is his third gas model, according to his letter, in which he also adds: "We in San Francisco generally fly our models at the Sunnyvale air base (former U. S. Navy lighter-than-air base)."

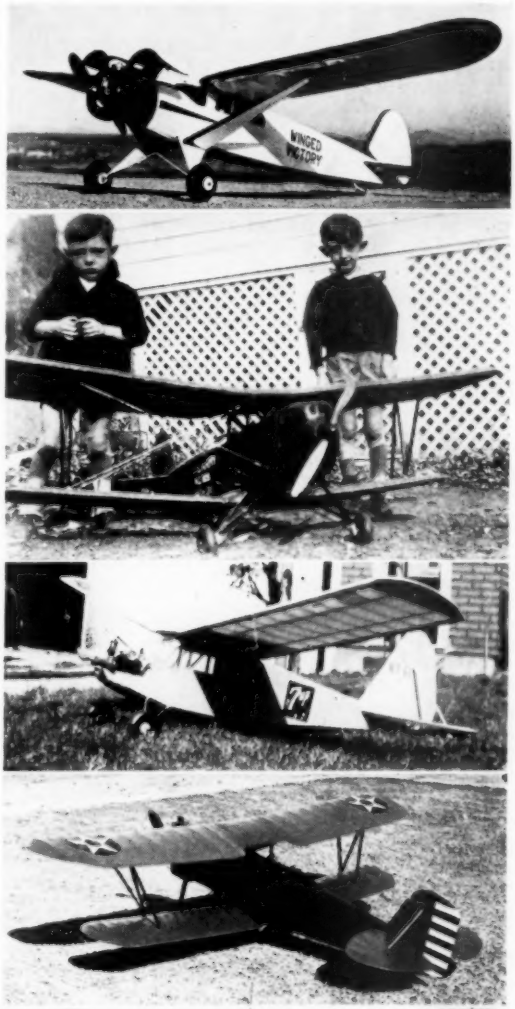
Another outstanding model built by a POPULAR AVIATION reader is the *Winged Victory* shown in the upper photograph on this page. It was built by another Californian, Elbert J. Weathers of San Diego. Span is five feet and the chord is 8¼ inches. The wing area is 442.42 sq. in., while wing loading is 1.2 lbs. per sq. ft. The ship's flying weight is 3 pounds 14 ounces.

The realistic model of the Berliner-Joyce P-16 pursuit ship was built by J. B. Oberthier of Plainview, Texas. The ship has a six-foot span and is powered with a ⅓ h.p. engine. According to Mr. Oberthier, his clean biplane's weight ready to fly is seven pounds. The wing is fitted with shear pins so that the wings will fall off in case of a crackup. "For test hopping," Mr. Oberthier writes, "I have a small knife switch attached to the side of the fuselage forward of the center of gravity. A 15 ft. string is attached to the switch.

"By running alongside, one can test his model for takeoff and glide —but a fast pair of legs are required."

Ralph Whipple of Morristown, N. J., built the 5½ ft. gas model that the two youngsters are posing with. "You will notice the absence of exaggerated dihedral," Mr. Whipple says in describing his ship, "and the almost-perfect scaling. The demountable wings have a 5½ ft. spread on the upper panel and four feet in the lower. Top speed is 45 m.p.h. and it lands at 12 m.p.h. The ship, including all internal bracing, weighs 5¾ lbs. loaded."

Although the seven-foot gas model built by Julian Millert of Argentine, Kansas, would be considered among the larger gas models, the ship only weighs 3½ pounds.



Some idea as to what a good gas model looks like can be obtained from these pictures of models built by our readers. Reading from top to bottom are Elbert J. Weathers' *Winged Victory*, an unnamed biplane by Ralph Whipple, Julian Millert's *Seven Up*, J. B. Oberthier's *B/J*, John Pond's *Cavalier* and Brooks Ferrell's *Miss America*.

Building the Howard DGA-8

by PAUL W. LINDBERG

Model editor and designer for POPULAR AVIATION airplane model builders.

Here she is—the Howard DGA-8, true to life with all work completed and ready to fly.

WELL, boys, if Benny Howard puts his O. K. on this model you can rest assured that it is the tops in gas models. This model has all the latest features that any gas model can incorporate.

This model is absolutely the latest word. The wing loading is 5/8 of an ounce per square foot. The wing struts are so arranged so that the wings may be adjusted to different dihedral angles.

Study the plan carefully in order that you may acquaint yourself with it thoroughly before going into the construction. After you have enlarged your plans, the fuselage is first tackled.

Construction of Fuselage

The main longerons are of basswood; all other pieces are of balsa. When the two sides have been constructed the cross members are next cemented into position. ½ inch No. 18 wire nails are driven through longerons into the upright and cross members of the fuselage.

From 1/8 inch sheet balsa cut the formers and cement them into their proper stations. 1/8 inch by 3/16 inch stringers are attached to the bottom of these formers. There are seven on the bottom of the fuselage and they are spaced evenly as shown in front view of plan.

The cabin and hatch in the top of cabin may be installed if so desired. One or the other will have to be installed so that the batteries may be moved back and forth to balance the model. The top of the cabin from windshield to hatch is covered with one piece of thin cardboard.

The photo of framework clearly shows the piece of body which is covered with cardboard and aluminum. One-eighth inch balsa ribs are attached to top of sides of cabin (see side view of plan). After all cross pieces have been inserted in top of cabin, 5/16 inch drilled dowels are cemented in and bound with heavy thread.

A 1/8 inch three-ply veneer firewall is attached to front of fuselage. Drive nails through the veneer and into longerons and upright pieces so that it will hold fast. The motor mount is made from 3/64 inch half hard aluminum.

Construction of Landing Gear

The type landing gear used on this model is very simple to construct. It consists of two pieces of 1/8 inch spring tempered steel wire. The front piece forms the axles for the wheels and continues up into the fuselage. The rear wire is bound to the front wire and continues up and across the bottom of fuselage. When these have been tied in place the balsa fairing is applied to form the struts. It is necessary to bind the balsa at the top and bottom with thread to prevent it from breaking away from the wire.

Elevator and Rudder

It is important that these be constructed on a flat surface so that they have no tendency to warp. The elevator is adjustable by means of aluminum hinges, clearly shown on plan. The stabilizer is adjustable by a friction fit and is held in any position desired by inserting a straight pin through stabilizer into upright blocks cemented in sides of fuselage.

Construction of Wing Panels

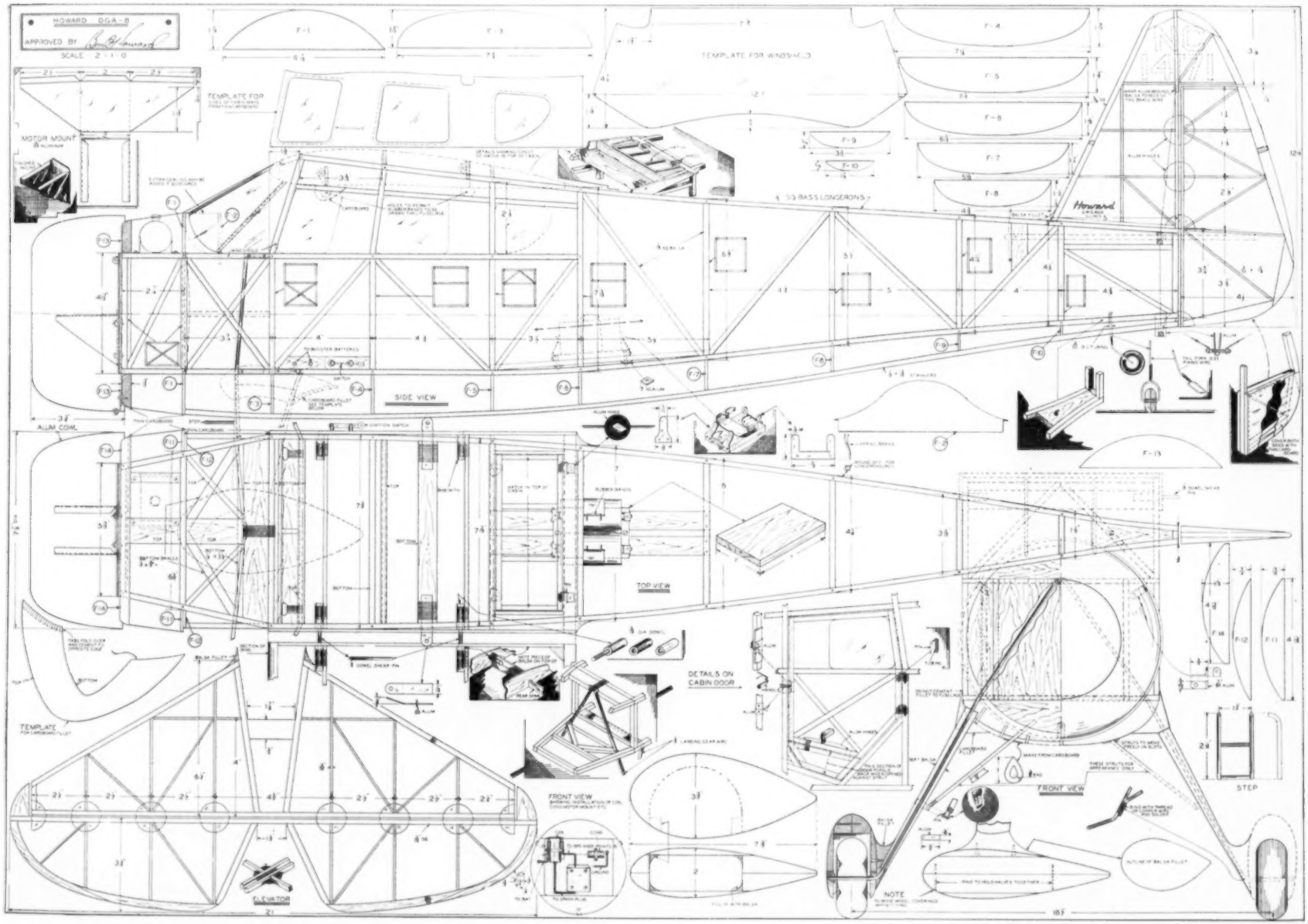
All ribs are cut from 3/32 inch sheet balsa. Spars, leading and trailing edges are then cemented in place. Do not omit any of the bracing between the ribs as this is necessary to strengthen them. Five-sixteenths inch dowels are cemented to spars at the roots of wings. Bind these with thread or string. The wings carry movable ailerons which are a great help when flying the model, as a small amount of wash-in is necessary to counteract propeller torque.

Covering the Model

The entire model is covered with a good grade of bamboo paper. In applying the paper to the framework, ordinary model airplane dope will not do. Ordinary cement, thinned out slightly, makes

(*Concluded on page* 56)

Just another view of the Howard DGA-8 model showing the top of the wings and fuselage.


HOWARD DGA-8
APPROVED BY
SCALE 2-1-0
TEMPLATE FOR WINDSHIELD
MOTOR MOUNT
(4 SPRUCE LONGERONS)
SIDE VIEW
TOP VIEW
DETAILS ON CABIN DOOR
FRONT VIEW
FRONT VIEW
STEP
TEMPLATE
ELEVATOR
NOTE
ALUM COWL

Building the Howard DGA-8

(*Continued from page* 54)

excellent paper cement. In order to obtain a nice covering job, see that practically all wrinkles are removed.

Do not stretch the paper so tightly over the frame that it will have a tendency to pull it out of shape. After the various parts have been covered, dope with water. This will cause the paper to tighten over the framework. If the brush is used, extra precautions should be taken so as not to tear the paper.

Any small spraying device is an excellent means of applying the water. After the pieces have become thoroughly dry, clear-dope them. To obtain a smooth finish, a light sanding is given between each coat. To finish off the model, color coats are applied. Color used on this model is orange trimmed in black with a white pin stripe. The white, a pin stripe is best applied with white lacquer in an ordinary draftsman's ruling pen. Keep the lacquer thin enough so that it will flow freely.

Assembling

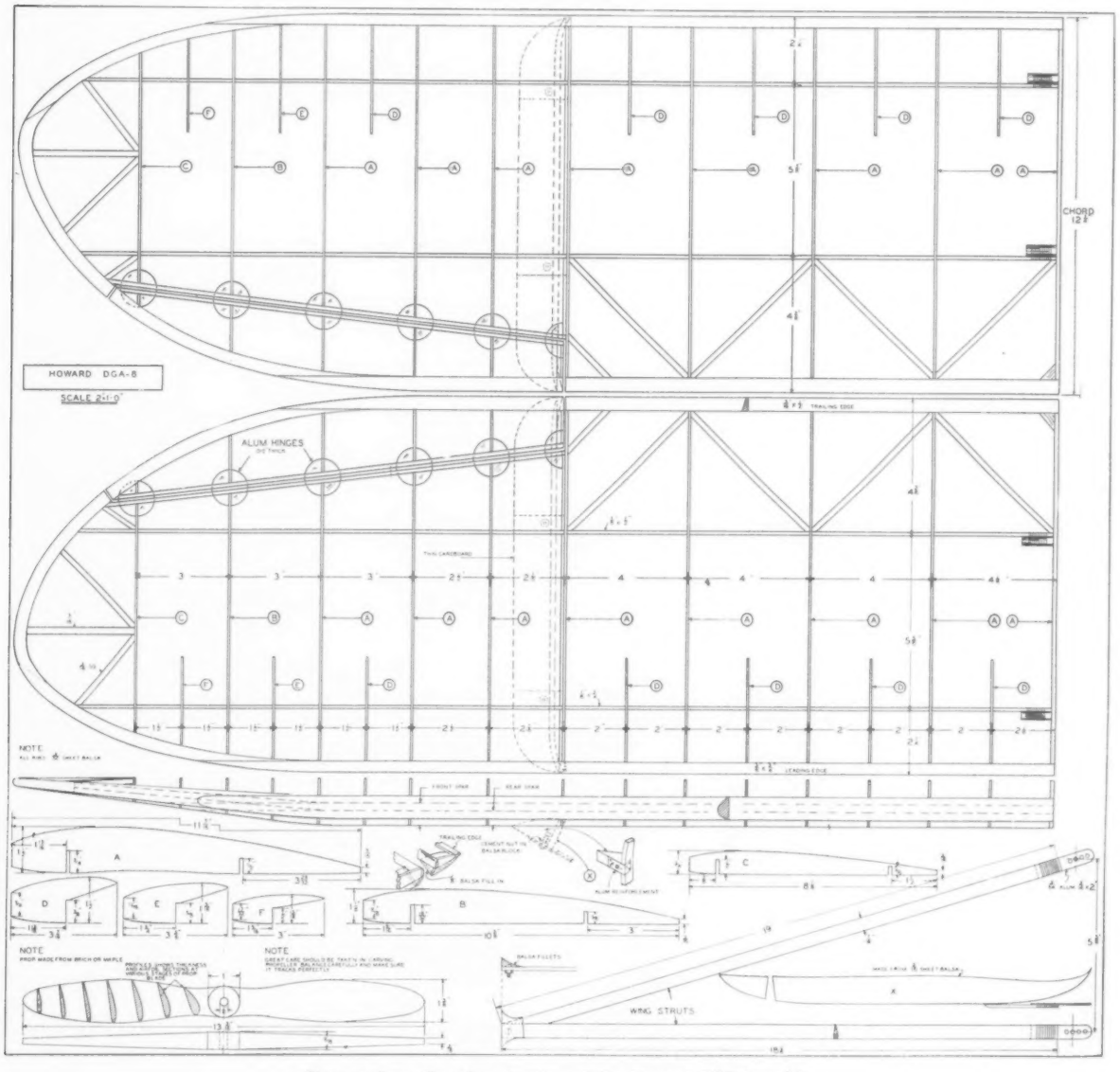
Extra precautions are required in assembling the model as proper alignment of pieces must be obtained in order that the model will fly properly. Please bear in mind that a little thought and study at this point will save many hours of additional labor in repairing your model.

This model has been successfully test flown before the plans were given their final O. K. So we advise you to adhere strictly to the directions in the plans.

One of the most important points to observe in making a test flight is to avoid obstacles and rough ground in the flight path that might injure the model.

IF YOU ARE UNABLE TO SECURE ANY OF THE PARTS TO BUILD THIS MODEL, OR IF YOU ARE IN DOUBT AS TO ANY PART OF THE CONSTRUCTION I WILL GLADLY HELP YOU IF YOU WILL ENCLOSE A SELF-ADDRESSED ENVELOPE WITH YOUR LETTER. ADDRESS PAUL W. LINDBERG, MODEL EDITOR, POPULAR AVIATION, 608 S. DEARBORN ST., CHICAGO, ILL.

END



Here we have the wing structure of the Howard DGA-8 model.

The National Air Board Says . . . .

(*Continued from page* 48)

Mr. Wilford's argument may be summarized as follows:

The ZMC-2 metal-clad has given six or seven years splendid service. The cover or skin itself takes up stress which is absolutely correct in engineering principle, a double cover is eliminated, gas leakage is reduced—in short the metal-clad airship is as much of an advance over the fabric covered airship as the modern metal covered airplane is over the old stick and wire, cloth covered type.

Mr. Young's main argument was that while it was possible to inflate a relatively small metal-clad though it had but one gas compartment, it would be impossible to inflate a really large airship having but one vast gas space. Only by subdividing into a number of compartments could inflation be carried out successfully. His suggestion was that a large dirigible might be built with conventional gas cell and structural design, but with a metal outer covering (since the metal outer covering would have better weathering properties, etc.).

If inflation is the only real difficulty, then we should concentrate on its solution, since the metal-clad airship is otherwise the more desirable type.

5. YANKEE INGENUITY AND THE AIRSHIP

Quoting from a statement by Mr. Wilford: "Yankee ingenuity must do for the German-made dirigible in improvement of design and efficiency what Martin and Seversky did for the D.O.X." We believe that Mr. Wilford is absolutely correct. All design personnel working on large airships have either been trained at Friedrichshafen or are strongly influenced by Friedrichshafen. And the United States has thereby splendid corps of engineers—with perhaps but one defect; too much reliance on tradition. Perhaps the next approach to large airship construction should herald a breaking away from tradition with attention given to some or all of the following ideas: 1. Shorter form with much larger diameter so that much higher load factors could be imposed before structural failure. 2. Use of bow elevators in addition to tail elevators as in the submarine. 3. Increase in propulsive efficiency by elimination of out-board gondolas. 4. Use of the metal-clad principle. 5. Above all a new and American approach to the problem of airship design.

6. A NATIONAL AIRSHIP POLICY

How and by whom should airships be operated? Why should the Germans alone have the privilege of operating them? If we have insufficient operating personnel could Navy personnel be given leave to work with commercial companies? Would it not be highly undesirable to allow the Government to operate airships on a commercial basis thus increasing still further the power of an already well nigh omnipotent, centralized bureaucracy?

The discussion of these questions ended substantially in one expression of opinion:

We should continue our efforts in the airship field, but these efforts should be not haphazard but based on a carefully considered national policy.

7. THE BARTOW CONTROLLED LIGHTING FOR LANDING SYSTEM

The Air Board was given a wonderful demonstration of the Bartow system in a carefully worked out model with small bulbs controlled just as the big lights would be; curtains of film paper to stimulate fog conditions. It would require a long technical paper to give a true understanding of the Bartow system which functions remarkably well under laboratory conditions and is about to be tried out under full scale conditions. Space considerations permit us to give only a few "high spots" of Mr. Bartow's splendid talk and demonstration.

1. It is hopeless to seek fog penetration by using special colors. Allowing only certain colors of the spectrum to penetrate means tremendous waste of illuminating energy. When fog is really thick all colors, no matter what their wave lengths, will be impeded. The proper line of attack is to concentrate great candlepower at the point where it is needed.
2. The retina of the eye is extremely sensitive to changes of intensity, and takes time to adjust itself to changes of intensity. The pilot's eye during a landing must be given light of uniform intensity.
3. The halo of a light in fog is caused by light shining at an angle to the direct line of observation and being bright enough to reflect off the drops of moisture, making them visible. When the distribution and intensity are controlled so that only the direct light (with just sufficient candlepower) penetrates to the point of observation, the light appears as a point source and the halo or fogging of the atmosphere about it is eliminated.
4. The most critical period during a landing, under condition of poor visibility, is just as the plane contacts the ground. At this time lights must be visible from a point 10 to 20 feet above the center of the runway which is the level of a pilot's eye when landing. If forward visibility at this time is 500 feet, a pilot can correct for wind drift, prevent ground looping and avoid dizziness brought on by the necessity of continuously re-focusing the eyes on close lights being passed at high speed.
5. Since most radio markers are 1,500 feet from the beginning of the landing runway (at which point the plane is supposed to have 200 feet altitude) the lighting system should be carried out 500 feet beyond this point and be visible from an altitude not less than 300 feet.

Mr. Bartow is applying all these principles by using two rows of carefully controlled ordinary lamp beacons placed 100 feet apart parallel to the runway, with the two rows themselves say 100 or 200 feet apart. With appropriate control of each beacon the pilot will observe at some 20 feet from the ground, mid-way between the two rows a row of controlled lights, all of equal intensity and entirely free from halo.

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. . . THAT since 1927 the Wright factory has been increased to 675,000 square feet of floor area—indicating the rapid advancement of commercial and military aviation.

. . . THAT a new four-story factory wing is now under construction which will increase the floor area of the Wright Aeronautical Corporation to almost 800,000 square feet—nearly 9 times the size of the factory at the time of Colonel Lindbergh's flight.

. . . THAT Wright engines, manufactured by this organization, power leading airlines throughout the world and many advanced types of military aircraft now being built for the United States Government under the program of increasing our national air forces for defense purposes.

. . . THAT Wright Cyclones power all of the luxurious 14 to 25 passenger Douglas Transports, Club Planes and Sleeper Planes now in service on American Airlines, Braniff Airways, Eastern Air Lines, Pan American Airways System and Transcontinental & Western Air—as well as many other leading airlines throughout the world.

. . . THAT Wright Cyclones also power all of the production order of huge four-engined Boeing Bombers, the latest twin-engined Douglas Bombers, Curtiss twin-engined Attack Planes, North American Army Observation Planes, the newest Grumman Navy Fighters, and many other advanced types of military aircraft now under construction for the U. S. Army Air Corps and the U. S. Navy, Bureau of Aeronautics.

. . . THAT the Wright Aeronautical Corporation is valued at more than $14,000,000 and that during 1937 an additional $1,350,000 will be spent in a new building and re-equipment program.

. . . THAT Wright Aeronautical is the world's most famous builder of aircraft engines as well as the largest aircraft engine manufacturing organization in the United States.

"Fly with Wright the World Over"

WRIGHT

AERONAUTICAL CORPORATION
PATERSON NEW JERSEY

A DIVISION OF CURTISS-WRIGHT CORPORATION

An Airy Chat with the Editor

(*Continued from page 12*)

with a minimum of fuel but it is a mighty expensive proposition to use for joy-riding or spending an idle Sunday afternoon.

* * *

FOR noiseless flying and for ability in sneaking up unnobserved, I'll have to hand it to the attack planes of the U. S. Army Air Corps. A squadron of attack planes slipped upon me so noiselessly when I was on the beach at Winthrop Harbor, that I had no warning of their presence until their shadows flitted over me. Close to the ground, they slipped around the corner of a sand dune with hardly an audible whirr of their propellers.

* * *

WE have had a lot of replies to a paragraph that appeared in the June "Chat", regarding the virtues and short-comings of thin wing-sections. The "ayes" about balanced up with the "nays" so that the matter apparently deserves more attention than originally contemplated when the article was written.

To judge from the contents of several letters, it is apparently a matter of familiarity with thick wing-sections and unfamiliarity with thin wing-sections that prompts the defense of the thick wing. The present generation have had but little opportunity to gain information first-hand from the thin wing-sections, hence the younger correspondents naturally defended the only wing that they knew by actual experience and thereupon denounced the thin wing as an out-of-date monstrosity that has no place in the modern scheme of things.

The statement that external bracing creates much resistance is quite true but this is a quantitative problem rather than a blanket statement that covers all conditions. At very low speeds, the effect of bracing resistance is practically negligible in proportion to the wing drag. However, the parasitic resistance increases rapidly until it reaches a point where it equals the drag of the wings and finally exceeds the drag.

It is obvious, therefore, that the resistance of the bracing used with lightplanes, below 125 m.p.h. is so low that a decided improvement will be shown when it is used in combination with a thin wing having an L/D above 22. The combined opposition offered by this arrangement is usually considerably below the overall re-drag of a thick wing section at low speeds, or at least this condition can be attained by careful adjustment of the thin-wing members. At high speeds—200 m.p.h. or more—the picture changes.

* * *

THERE are many of the boys picking up real money in photographing industrial plants—and even strikes at industrial plants—from their planes. Others are taking photographs of summer resorts and dude ranches for advertising literature, and so on.

Now, while the best results are only obtainable with the special aero cameras now on the market, good pictures can also be obtained with revamped hand-cameras, re-arranged to withstand the wind-pressure.

The modern reflex type miniature with a focusing tube but with no bellows, is well adapted to this work and can often be used with very little alteration. Cameras of this type are the Exakta and the Korelle Reflex having lenses of speeds f:3.5 to f:2.5.

We hope to print some material of this sort in an early issue that will be helpful to all those intending to enter this game. J. B. R.

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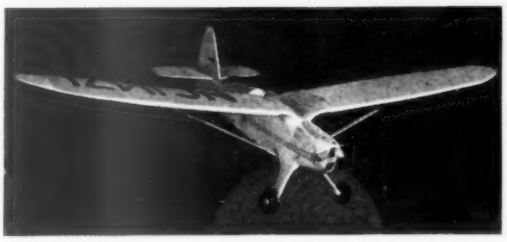

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P. V. H. Weems

(*Continued from page* 34)

error due to accelerations. Fortunately, however, this error is more apparent than real.

It is true that a single observation might give an error of more than 25 miles, it is also true that an average of ten or more observations will reduce this error, under average conditions, to within five miles, and in this connection, averaging sextants will soon be on the market which will simplify the operation of averaging a string of observations.

We therefore have the situation where marine celestial navigations was adopted for air use and within ten years has been so far developed that the mariner, if progressive, will use the methods and equipment especially developed for the air, including short tables, bubble sextants, navigation second setting watches, the Greenwich Hour Angle Almanac (already in common use), special plotters, and other items.

I predict that within ten years celestial navigation will find its principal use in the air—this because there will be more aircraft using it than there will be marine craft. The fact that Pan American Airways planes are able to pick up an island 200 feet wide and four feet high with celestial navigation methods is an indication of what the future holds for air navigation.

While it is true celestial air navigation has great possibilities, it is also true that this method is relatively little used or known. Some of the outstanding users of the method are: Lindbergh, Byrd, Ellsworth, the late Marquis de Pinedo, Coutinho, P. G. Taylor, Gatty, Waghorn, Lambie, Amy Johnson, Connor, Pan American and other airline navigators and military and naval navigators. One of the outstanding feats of celestial air navigation was the accomplishment of Gatty in safely navigating Bromley back to Japan after flying twelve hours out over the Pacific and being forced to retrace their course due to engine trouble.

The bubble sextant is the weakest link in celestial air navigation, though without further improvement air navigation is entirely feasible. Any person with average intelligence and a high school education can master the subject, and it is a field well suited to women as well as to men, as witnessed by the performance of Anne Lindbergh and Amy Johnson.

Navarre

(*Continued from page* 18)

ON MAY, 1916, Navarre was Fokker hunting. Above the front lines, near Douaumont, he soared slowly, indolently. To learn the secret of the German synchronizing device he must force a plane down within the lines of the Verdun sector. Hopefully he waited to bait a Fokker pilot.

Soon three Fokker high-wingers came charging down on him. Navarre hi-tailed it back of his lines. The Fokkers outnumbering the Nieuport three-to-one gullibly followed. Navarre flying at reduced throttle, permitted the enemy to overtake him.

Quick as a flash he gunned the Gnome and sent the Nieuport up in a thundering zoom. Over in a mad loop the Nieuport went, trembling under the strain. Then down swept Navarre, his struts and wires screaming in protest. The Boche scattered. Navarre pounced upon the nearest one and taking careful aim so as not to set the Fokker afire, he shot away the tail assembly as the Nieuport danced and rocked crazily. Down went the Fokker to land with a rendering crash.

By now, the remaining two Fokkers had time to recover from their surprise. They came at the French plane; one was three hundred feet below Navarre, the other was 1,000 feet above and directly over his flying mate.

With all the guile that had made Navarre famous, he feinted for the lower one, going into a dive. The Fokker up above came slicing down. Quick as a flash Navarre pulled into a zoom, heeled over into a vertical bank. Pivoting on a wing tip he sent a deadly burst into the out-maneuvered Fokker to send it down in flames. This double victory brought his score up to 12 enemy planes shot down.

The French were not used to flying of this sort. The fact that he had bagged two ships by using his machine-gun synchronizing device didn't enter into the French mind. Here was just a *pilote extraordinaire*.

Navarre had put fight into the *chasse escadrilles*. Now this double victory, which revealed the synchronizing mechanism, quickly put synchronized machine guns on all the French and British battle planes on the Western Front. A supreme gift to the Allied air service.

END

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The Amateur

(*Continued from page 28*)

manship, materials and conformity before the covering operation.

After the data and test plane are approved and the approved drawings and instructions are available to the homebuilder, the homebuilder must have his finished ship inspected before covering by a Department inspector. It is inspected for workmanship, materials and conformity. It will then be issued a license after test flown by a transport pilot.

The approved plans are available from the designer or organization responsible for the designing of the plane and will consist of drawings and instructions necessary to insure proper construction by the homebuilder.

Therefore, for an amateur organization to furnish its members with such approved plans it would be necessary to design or have designed a plane according to the Department of Commerce requirements which would require the services of an aeronautical engineer. Also of further expense would be the building of the first plane as required by the Department.

It is obvious that such a plane would definitely be a lightplane and should be very simple to build, yet retaining a good all around design—nothing radical. It should be a two-place of about 40-50 h.p. A removable cockpit enclosure would be a good feature. It would necessarily have to be as much up to date as possible in connection with fairing, etc.

The next question is how to make approved plans for such a plane available to the amateur at little or no expense. To begin with an estimate of the total cost for design approval and construction of first plane should be made.

First, the services of an aeronautical engineer must be obtained. Any engineer who has had any intimate relations with amateur aviation should be willing to do the stress analysis and other smaller supplementary engineering work, according to Department of Commerce requirements for $500. This figure may seem to be estimated rather low, but however this fee should not be higher due to the fact that the design is simple.

The materials for the test plane should not cost over $400 at the most, otherwise it would not be suitable for the homebuilder. A motor should be available for $200 and would not necessarily be new. Then allowing $200 for labor expenditure. One or two mechanics could build such a ship in a short time. Then an additional $200 for incidental and unforeseen expense would make the grand total $1500. Incidentally this is about the fly-away price one has to pay for a licensed factory-built lightplane.

It would be a pretty good bet that every honest-to-goodness amateur and private flyer would chip in a small amount to raise this sum if he knew he would receive a set of approved plans for a nifty little plane with the stamp of approval from the Department of Commerce, with no worry about grounding of good home-built ships by pesky state officials.

Three hundred charter members in such an amateur organization at a membership fee of $5 each would be sufficient to pay the cost of licensing a home-built lightplane design, each member being rewarded with a set of approved plans and instructions with which he could easily build a licensed lightplane. The average cost of a set of plans of this kind is at least $50, obtained at ordinary sources.

If the amateur homebuilder would organize on a policy of this kind it would undoubtedly solve the present regulations problem to a very great extent.

END

Airplane Design

(*Continued from page 50*)

(1382/9) 154 sq. ft. and an A.R.6 will give a chord factor of 25.6; scale No. 2 indicates a chord of 5 feet. Multiplying the chord by the aspect ratio (5 × 6) gives the span of 30 feet, and multiplying the span by .70 or using scale No. 3, the overall length is found to be 21 ft. Scale No. 4 gives the horizontal tail surfaces a span of 102 inches.

The power loading is (1382/70) 19.7 lb./h.p.; multiplying it by the stalling speed (flaps up) or 52 m.p.h. gives a factor of 1030, which shows on scale No. 6 a speed ratio of 2.1. Multiplying it by the stalling speed will give a top speed of 109 m.p.h. On scale No. 7 the factor 1030 shows that an absolute ceiling of 12,000 ft. could be reached, and that the climbing speed of 9000/19.7 or 450 f.p.m. may be obtained. With a high efficiency propeller the climbing speed may be increased 20 percent.

The number of gallons carried is estimated to be equal to the number of horsepower divided by four; for above example 70 divided by four equals 18 gallons. The duration of the flight at full power then is 2½ hours.

The preliminary design is followed by repeated weight and performance estimate in connection with stress calculation for correct dimensioning. While building, repeated weighing and balancing—leaving the wing or engine unit for final assembly—will insure a close check with the preliminary design.

END

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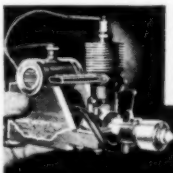

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P-8

Blind Landings Will Be Next

(*Continued from page 34*)

an inclined glide path which can be followed down close to the landing field.

There are two other small transmitters, short-wave radio markers, on the ground. One is placed 9,000 ft. from the edge of the field and the other approximately 900 ft. from the edge of the airport along the directional beam. The first one provides a definite fix for the pilot, informing him he is a mile and two-thirds from the field to which he is flying. The second marker notifies him it is time for him to land.

In the airplane are two receivers. One is sensitive to the directional signals. These are heard by the pilot in his earphones and also actuate an electrometer or dial on his instrument board. The dial has two indicators, one showing the relation of the airplane to the guide path, the other showing the relation of the plane to the glide path.

The second receiver in the plane is sensitive to the marker beacons. The signals are transformed into sound which the pilot hears simultaneously with the on-course signal from the directional transmitter. These signals from the markers are heard for only the few seconds the airplane passes through the marker signal pattern. The marker signals also light lamps on the dial as further checks.

When the system is in operation the pilot locates the ultra-short wave runway and centers the directional and glide path indicators on his instrument. He then heads toward the field flying at any elevation between 500 and 1,500 ft. as he passes over the first marker. Preferably his plane should be about 800 ft. here.

At an airspeed of 100 m.p.h. he will cover the next 9,000 ft. in approximately one minute, so in following the glide path the plane descends 700 f.p.m. with throttles almost closed. Then he passes over the inner marker, the bulb on the dial glows briefly and he hears the signals.

He knows there are no obstacles to his flight in this final section of the landing path and can, consequently, further reduce the height of flight in order that he may bring his machine down safely even when ground visibility is poor. Remember the Lorenz is a "low approach" system and the pilot is expected to see the ground briefly before he finally puts his machine down.

The Washington Institute of Technology's "Air Track" is a true blind landing system. This was developed from the original Bureau of Standards system and now is offered for immediate installation at any airport.

The Air Track consists of two beams transmitted simultaneously from the same point on the ground. One of the beams is directional, and outlines a runway for an incoming airplane. The other is an ultra-high frequency glide path beam. Signals from this second transmitter are directed slightly upward. They consist of pear-shaped lines of constant field strength, and these lines provide glide paths of varying steepness which converge along the runway outlined by the localizer beam.

In addition to these two beams there is a radio marker beacon at the edge of the airport to warn a pilot that he is at the margin of his landing field.

The unit for the airplane is very simple. It consists of an electrometer with two pointers. The vertical pointer indicates the relation of the airplane to the localizer beam and the horizontal point its position with regard to the glide path. When they are crossed at an angle of 90 degrees the airplane is following its proper course.

Tests with this outfit have shown that it is very positive in its action. Landings have been made with the cockpit entirely hooded so the pilot did not see the ground until after bringing the airplane to a stop. The pilot is forewarned of his proximity to the ground by the marker beacon which is received aurally at a time when his plane is from 15 to 25 ft. off the ground.

All of these systems require considerable skill on the part of pilots and also require concentration of attention and the ability to make highly important corrections in flight attitude from readings of a number of instruments at the same time.

Dissatisfied with these systems which have been in progress of development for five or six years, a group of engineers from United Airlines, Transcontinental & Western Air and the Bendix Radio Corporation, have for two years been carrying on a series of experiments upon a blind landing system which would be fool-proof.

Their attempt is to eliminate the opportunities for human error from blind landings and to do this they sought to carry the W. I. T. system several steps further. At this time, according to reports from Oakland, Calif., their experiments are bearing fruit in a truly amazing fashion.

They developed an ultra-high frequency glide path and a localizer beam very similar in most respects to the W. I. T. Air Track. A similar dial arrangement is also placed in the airplane.

But they also arranged a hookup of the radio signals to a Sperry automatic pilot. They now say that with some minor aid from the human pilot the radio controlled automatic pilot will bring planes in to perfect landings. The human pilot need never touch the airplane controls.

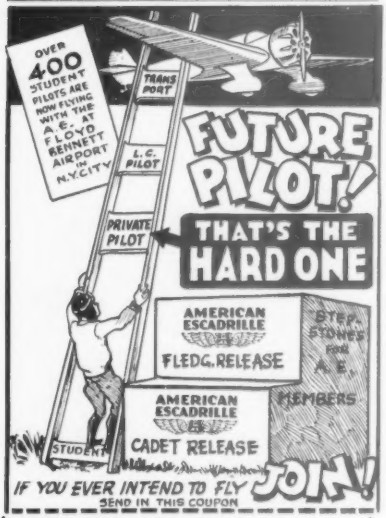
The engineers report, also, that the Sperry pilot and the radio together are much more precise in their handling of an airplane than the best of human flyers. More than 400 landings of several different types of large modern transport airplanes have proved this to be fact.

In using the radio controlled automatic pilot the airmen hood their cockpits and then tune the radio receivers to the frequencies of both the localizer and the glide path transmitters. These receivers are hooked to the automatic pilot.

Then the human pilot, by turning the knob control on the automatic pilot, proceeds to maneuver the airplane until it is headed toward the field and exactly down the glide path. Once set on this course the airman throttles his motors so that the plane has a small margin of speed above stalling and sits back to let these automatic servants do his work.

Occasionally the human pilot will make slight corrections to compensate for drift or bumps. These are done by touching the automatic pilot's adjustment knobs. Then as the altimeter registers only a few feet above the ground the human pilot sets the brakes on the wheels to a full on position.

The plane is flown right into the ground but because the radio glide path flattens out above the airport the contact is not a hard one. As soon as the wheels touch the airman closes his



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throttles. With the brakes on the plane has a tendency to nose over but this is prevented by the automatic pilot hauling back on the stick far more quickly than could a human.

The engineers report that the results are absolutely consistent with this device. Different types of ships land at slightly different angles and stop at slightly different positions on the field but the pattern is very close for all the planes in which the experiments have been tried.

This system was perfected with the Douglas DC-4 and the big Boeing four-motored transports in mind for the first commercial installations. The Douglas four-motored plane will have a nose wheel which should make the "flying on landings" very easy for both pilots and passengers. This nose wheel also will be a positive preventative for upsets due to skidding of the wheels at landing.

With this nose wheel, the Douglas will be able to land safely in practically any direction, regardless of the wind direction. Blind landings with this ship, then will be commonplace.

Although engineers are now satisfied that their radio-gyro pilot is a perfect instrument, no passengers will be landed with the device until after another year or more of testing, most of which will be conducted in the big new ships which have not as yet been flown. The airline engineers also say that if the tests are not satisfactory one of the other three instrument landing systems herewith described will be adopted.

END

Rotor Planes

(*Continued from page 48*)

in the air stream. It is so designed that the air strikes the hollow half cylinder, driving it backward, while the convex is forced forward against the air stream.

Because of the great resistance to the air stream on the upper surfaces, the stream is thrown upward, curving over the top of the wing a considerable distance from the upper surface and joining the air stream from the rear, increasing the normal vacuum which occurs above the wing three or four times and creating an enormous increase in lift.

Under these conditions a considerable burble of the air over the upper wing surface might occur if it were not for the fact that a certain amount of the air stream which strikes the rotor passes through underneath the rotor close to the upper surface of the wing, creating the effect of a wing slot.

It is said that tests of this device have produced remarkable results, which however the inventors wish to keep secret until they have completed their tests.

At the present time there are several new rotor planes under construction in the East and on the Pacific coast, and much will be heard from this type of plane in the near future.

END

Standards

(*Continued from page 26*)

Plane, was built for what was then termed the "United States Post Office Aerial Mail Service." This equal span biplane with its stubby landing gear was used in the early days of the air mail experiments and it gave a fairly good account of itself.

A large single-place job powered with the 150 h.p. Hispano-Suiza engine, the craft was characterized by the fact that the bottom wing was in two distinct sections and did not extend under the fuselage which was raised slightly above it. There was a medium gap between the wings, the tail surfaces were of medium size, and a small head rest was provided for the comfort of the pilot. There was no sweepback to the wings and all interplane wiring was reduced to an absolute minimum. All controls were unbalanced.

The JR-1-B also appeared in slightly modified form as a two-seater observation plane. This ship, known as the E-4, was identical with the JR-1-B except that there was some overhang in the top wing and that skids were fitted to the bottom wings.

Although there were several other Standard types and models produced, the ones mentioned are the most important and interesting.

Caught in the post-war lag, the Standard concerns struggled on for a time, then left the picture.

END

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THE GENERAL TIRE & RUBBER CO., AKRON, O.

Hughes

(*Continued from page* 46)

completed he took it out and taxied about the field.

If something did not suit him perfectly he would take the ship back to the shop and with great thoroughness and care would make any alterations necessary. But with all this thoroughness he did not seem to have any set procedure. At times his men did not know when he was going to make a flight but were always to have his ship ready. Likely as not, Howard would get up in the morning, grab any clothes he could find in his room, rush to his awaiting plane and be off for some destination perhaps 3,000 miles away.

This was such the case when he first test-hopped his latest low-wing racing plane, according to an eyewitness. Following several anxious days of testing his ship on the ground, Howard was taxiing along the runway, when without warning he was seen to leap into the air. He was off on his first hop!

When Hughes takes off with the ship he pulls the wheels up when about 25 or 30 feet in the air and then begins to climb fast. On one of his first hops he was in the embarrassing position of not being able to get the wheels down again when coming in for a landing. The hydraulic system would not work, and he yanked an emergency cable to try and pull them down.

When bouncing around in the air at about 300 m.p.h. in a plane as his, trying to pull a stuck landing gear down is quite a hair raising problem. Undoubtedly perspiration came forth from that man Hughes. Fortunately he lowered the landing gear far enough so the plane could be landed safely.

That incident reminds us of the 1936 National Air Races when that daredevil, Harry Crosby, spent the good part of a nice sunny morning careening through the air with his racer trying to get his landing gear down by jerking out of dives until it finally reached the extended position.

The few hours preceding a test hop of a racing plane are usually the most nerve-wracking to the pilot. When he once gets the ship up the climax seems to have passed.

It is said that Hughes, while waiting to fly his plane, would borrow a Great Lakes job and fly it over the countryside so as to keep the "feel" of flying an airplane. He would land, take a look at the progress the mechanics were making on his steed, and would then take off again. On one of these occasions he flew Vance Breese's low-wing racer. It was very humorous the way he hopped in and out of airplanes while waiting for the completion of his plane, but not so to Howard Hughes perhaps.

It cost Hughes in round numbers about $100,000 to build his racer. Soon after completion and test flights Hughes flew his ship over a measured course at Santa Ana to endeavor to break the world land-plane speed record. He made four dashes and apparently broke the record by a large margin, but the judges declared it unofficial for various and sundry reasons, mainly because of his dive before entering the straight-away which is prohibited.

However, Hughes went up the next day for another attempt. His cockpit enclosure was now missing as it had blown off during one of the speed dashes leaving him in an open cockpit which considerably cut down his speed. It also made the ship tail heavy and at top speed the racer was unmanageable.

Therefore, Hughes had to throttle back somewhat and make the speed dashes at that speed. Nevertheless, on one of four dashes that day he did slightly over 352 m.p.h. to break the existing speed record! His engineers had figured about 350 m.p.h. as the top speed, and that was with cockpit enclosed.

But no sooner had he completed the dashes than the engine of the sleek racer quit. Hughes spotted a newly plowed field down in front of him and attempted a landing with his wheels up, simulating a snappy sleigh ride. Thanks to Mr. Stryker's keel the ship did not fold up like an accordian as I have seen some racers do.

It is always better to land with the wheels up on such a field as otherwise the plane is liable to turn turtle (we unwittingly had the ship change into an accordian and turtle, in the preceding two sentences but we know you grasped the right meaning). Little damage was done to the racer, and it was brought back to Hughes' modern but minute factory at Burbank, California.

From then on, all sorts of rumors flourished. People said that the plane was purchased by the Army to be developed into a pursuit. Others said Hughes would try to break some speed records made by the French flyer, Detroyat, at the 1936 National Air Races.

Finally, the rumors ended when one morning Hughes took his ship out for a test hop, and lo and behold it had a new wing. This wing was long and narrow as compared with the short stubby former wing. It had the N.A.C.A. 23012 airfoil section, the most efficient yet designed. Hughes' ship by these modifications was now a long-distance racer, and Hughes predicted that it would do about 360 m.p.h.! It was to be delivered to the Army.

In the Hughes manner it was delivered. Taking off one morning he flew it to Newark, New Jersey, making his famous record-breaking flight. It was his own record that he had broken which he had established in Miss Jacqueline Cochran's Northrop *Gamma* some months before.

From there our guess is that it went to Dayton. It will undoubtedly be tested for stratosphere flying by the Army engineers, and it is not impossible that speeds of around 500 m.p.h. may be obtained with it with tail winds that are encountered at about 35,000 feet altitude.

With an enormous top speed like that the racer has a very slow landing speed which makes it ideal for military purposes though it will probably have to be throttled back in order to maneuver it in combat. It would take a radius of about five miles to turn the ship when "wide open" without making the wing appear as if it was hinged to the fuselage

Ordinarily at low altitude it will do 160 m.p.h. Both figures are at cruising speed. So Howard Hughes may take to the stratosphere on his forthcoming flight, and it shall be interesting to watch his progress.

It is fortunate that our industry has such a man as Howard Hughes who is willing to risk his life in the practical development of high speed aircraft.

END

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Construction Set complete, postpaid..... $4.50

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This new model, built very strong yet light in weight, is practically crashproof and will out-perform any large scale model built. Rises from ground in 10 feet and flies over 650 feet. Set contains all parts printed on balsa, ready cut pant cores, 4¼" turned motor front, 11" steel type carved paulownia wood propeller, 2½" balsa wheels, tail wheel, formed wire parts, 26' rubber, 2 oz. yellow dope, 2 oz. blue, ¼ oz. black, 2 oz. glue, cement covering, full size scale drawing, and all parts.
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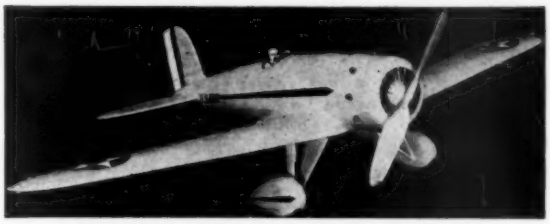
Note: In issuing money orders, use St. George, N. Y., postoffice

NEW LOCKHEED P23A NAVY FIGHTER



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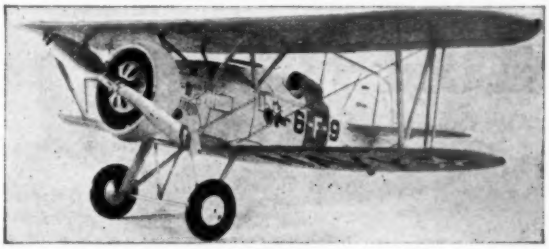
New 4-gun Navy fighter. Model will rise from land or water in few feet. Construction set contains fuselage and pontoon formers, wing ribs, tips, etc., printed on balsa, a 3¾" turned cowl front, 2 instrument boards, colored insignia, lettering, windshields, 9" carved scale flying prop shown, 3 oz. silver paint, 1 oz. cement, ½ oz. black, 2 oz. glue, ready cut wheel pants, strong 2" aluminum wheels, 12 feet of rubber, and large 33"x44" drawing of land and sea plane. This is a sensational model and only one of its type in the world.
Construction Set in labeled gift box, postpaid..... $2.95
Above model is latest improved type, just out.

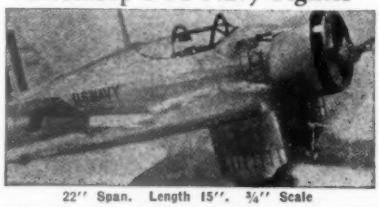
NEW BOEING F4B4 NAVY FIGHTER



22½" Span. Length 14½". Weight 2½ oz. Color, Grey, etc.

This is the finest equipped Boeing, F4B4 model in the world. New improved model exclusively equipped with new 3¼" special aluminum streamline tapered cowl ring, 9 cylinder celluloid motor with aluminum ventilator front, 8" carved varnished steel type propeller, printed out balsa wood parts, 2 oz. grey dope, ⅛ oz. yellow, ⅛ oz. red, paper cement, glue, formed wire parts, celluloid wheels, tail wheel, U. S. Navy lettering, colored insignia, and ¾" scale drawing. **Construction Set complete, postpaid..... $2.95**

Northrop FT1 Navy Fighter



22" Span. Length 15". ¾" Scale

A beautiful flying model of the latest Northrop 280 m.p.h. fighter. Set contains 3" turned motor front, 8" carved propeller, insignia, silver, black and clear dope, glue, all parts printed on balsa, full scale drawing, and all parts to build as shown.
Construction Set complete, postpaid..... $2.00

Boeing P26A Army Fighter

22" Span. Length 17½". ¾" Scale

150 of this fast pursuit plane are now in use in the U. S. Army. Construction set has 3" celluloid motor, 3⅛" tapered aluminum cowl, 8" steel type prop, set of colored paints, glue, etc., insignia, drawing, printed parts.
Construction Set complete, postpaid..... $2.75

Lockheed Electra R-20-1

27½" Span. Length 17". ½" Scale

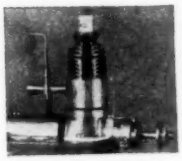
Set has all parts printed on balsa, turned motor fronts, carved steel type props, set of 3 colored paints, glue, etc., balsa wheels, concealed motor unit through fuselage. Scale drawing.
Construction Set complete, postpaid..... $2.95

Northrop A17 Army Attack

24" Span. Length 17". ½" Scale

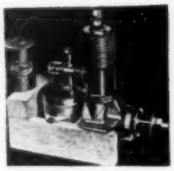
Exact scale model of one of the 125 new attack Northrops just ordered by the U. S. Army. Set has 2½" turned motor front, 7" steel type prop, insignias, set of colored liquids, glue, etc., all parts printed on balsa, full size scale drawing, and all parts.
Construction Set complete, postpaid..... $2.50

Chunn 1/10 H.P.



This fine little motor is for models of 3½ to 4-foot span. Weight 4 oz. Comes complete with coil condenser and gas tank ready to run. 1/10 h.p. at 3500 r.p.m. ⅝" bore, 17/32" stroke.
Price..... $17.50

Brown Jr. 1/5 H.P.



Long life motor with steel cylinder and piston for models of 5 to 8-foot span. ⅞" bore, 1" stroke. Complete as shown in illustration, ready to run.
Price..... $21.50

LOCKHEED VEGA GAS MODEL

82" Span. Weight with motor 5 lbs.

Set contains formers, ribs, tips, pants, etc., all ready cut to shape, 8¾" turned motor front, 4½" rubber tired air wheels, silk covering, glue, and full sized drawing. This is a dry set without liquids.
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MINIATURE AIRCRAFT CORP., 83 Low Terrace, New Brighton, New York

Plane's Life

(*Continued from page* 20)

How long will the new crop of airplanes last? That would be difficult to state; but engineers are positive they will far outlast the airplanes of ten years ago. Still, metal fatigue is far from a positive science, and new things develop all the time. Failures occur where and when least expected.

The huge four-engined bombers bought by the Army will have usefulness as passenger carriers for some years after they have been declared obsolete *in performance* as bombers. After a career as passenger haulers they will still be useful as cargo carriers. So say engineers.

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Will We Have Air Detectives?

(*Continued from page* 28)

But he'll be more than an air cop. He will be a pilot acquainted with all types. He will have a system worked out that will check tire marks and tracking widths of undercarriages. He will known the various types of slashes, the various types of tail skids cut, or the particular wriggle design left by a tail wheel. These will be his fingerprints to trace the crook plane. He will develop an ear for engines and tell by the beat or hum what make and horsepower it represents. He will be able to identify every plane by its silhouette with greater accuracy than that displayed by wartime pilots who sought the enemy "over there."

He will know every pilot by name and have his history filed for instant consultation. He will know the particular twists in their make-up. He will study their takeoff and landing styles, for every man leaves his mark somewhere on, or above the runway.

Our air detective will be an expert in military planes and know their armament. He will be a ballistics expert and will be able to trace machine gun bullets and the gun that fired them. He will even be able to determine the angle from which they were fired and in all probability the distance.

He will know every field and hangar in the country, or he will have comprehensive files of information on them. He will know every travelled air route and its typographical problems. He will devise a network that will tie up every emergency landing field in the country. He will know the exact position and movement of every plane in the country, just as Lloyds knows the position or destination of every vessel on their insurance books.

The crook may find new fields aloft to try his hand on, but he'll find plenty of trouble when he comes down with the loot. The air detective with his high speed patrol plane, his radio and his list of awkward questions will make aerial banditry a pretty tough proposition, even if he manages to survive the blast of gunfire the air detective rains on him.

It'll be nice work for someone, if he can get it.

I have no idea how much this proves or disproves Criminologist Harker's theory, but I do know that when POPULAR AVIATION prints this, about 500 air thriller writers will have a new character.

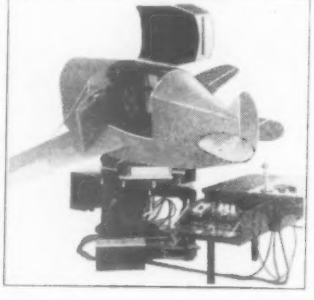
Which reminds me, I might as well get to work and write a story myself.

END

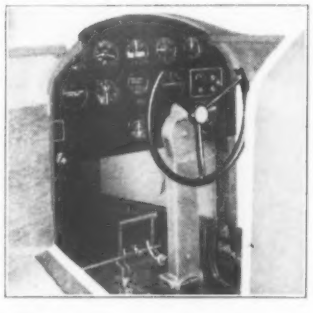
EASTERN AIR SCHOOLS
INCORPORATED
SALISBURY, NORTH CAROLINA
COMPLETE AERONAUTICAL TRAINING

Eastern Air Schools has now completed its new training and repair base at Salisbury, North Carolina, and is training students and operating its new repair base.

In accordance with its policy of offering only the best of equipment for the training of its students, Eastern was the first of the better air schools to purchase a Link Trainer.



The Link Trainer is a mechanical device for the training of students in blind flying. It is recognized by the Army, Navy, Marine Air Corps and all leading air lines as well as greater foreign governments as the safest and most efficient method of teaching blind flying which has yet been devised. To insure proper training for its students, Eastern has engaged the services of Lt. H. H. Culler of the Army Air Corps who comes directly to Eastern's Blind Flight School from the Army and the Department of Commerce Link Trainer Instructor's School. No finer training equipment or personnel can be found in America.



Equipment at Eastern includes all weights of ships and all powers and speeds including the New airline equipped Stinson which will be used for cross country training by airline students.

What One Woman Thinks

(*Continued from page 52*)

steward would come in pretty handy back there. And suppose someone wanted a cup of hot coffee? Do men not make the better waiters and chefs? Are their hands not steadier than the hands of women? Are the greatest surgeons not men?

And what of the women passengers? Most women are not physically beautiful, but would like to be. Most women who fly on airlines do so because they prefer that method of traveling to trains and boats.

When a perfectly groomed, freshly painted, beautiful young hostess presents herself to these women, smiles charmingly and displays a disgustingly even set of gleaming white teeth, what are their reactions?

Do they not become immediately conscious of their own unavoidable untidiness and, in some instances, their lack of youth and gleaming white teeth? Is the vanity of women too unimportant for airlines to consider, in view of the fact that the vainest women are prone to have the most money and time to spend traveling?

And what of the male passengers? For the most part, do these men not consist of lawyers, business executives, doctors, and others whose time is valuable and who are physically fit to travel and to work? Of retired business and professional men who are anxious (or should be) to join their families in California and Florida? Are these honorable gentlemen interested in beautiful young ladies, or should they have occasion to become interested in them?

When they are sick they need nurses; when they are well enough to travel, decidedly they do not need nurses. I think their wives will agree with me on this point, at least.

So much for the hostesses—on the ground; and so much for the "abuse of our beloved aviation"—in the air.

Because women simply must always have the last word no matter where they are, I cannot refrain from casually mentioning that, in my self-styled expert opinion, "on the ground" is not such a bad place to be, after all. It's cold up above and hot down below, while Spring is in the air—near the ground.

EDITOR'S NOTE. This story, the first that we have ever received of the kind, opens up a new view-point for discussion, both for our readers and writers. There are many, many views on the subject of women in the various branches of aviation and particularly where the woman in aviation meets the travelling public. The Imperial Airways have employed men stewards for many years on their Oriental runs, and are obviously satisfied. END

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Although it is very hot and you are probably sweltering with the heat, just as we are doing at the present moment; we simply MUST tell you of these BARGAINS. Regardless of how warm you may be, it will be well worth your while to take a look at the merchandise offered for this SPECIAL AUGUST SALE.

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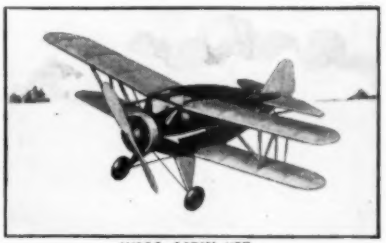

WACO CABIN "C"

Kit to build this Waco Cabin "C" Flying Model given FREE to all who subscribe on this Special Summer Subscription Sale. Complete kit including many finished parts such as wheels, propeller, wire fittings, nose plug; also full-sized plans, printed balsa, etc. Made especially for us by a well known manufacturer. A model that will give you much pleasure building and hours of enjoyment in the air.

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The Design of Landing Gears

(*Continued from page 50*)

Then, taking the loads in the side legs, 3,800 pounds, and breaking them up into their individual loads we have: the resultant, 3,800 pounds. This is in the same plane as the shock strut, and the shock strut must be at right angles to the fuselage, measured fore and aft, in order that the axle will not twist when the wheel moves up and down. It follows then that the resultant meets the fuselage at an angle of 90°. So on the side drawing of the landing-gear we draw a dotted line from the point of intersection of the two struts in the center-line of the tire up to the fuselage, making a right angle to the fuselage, (D) on the drawing, this is the line of the resultant.

We measure our angles from it and not between the struts, angles 9° and 40° on the drawing. Then the load in the rear strut C, is:

$$\frac{1}{\sin[180^\circ-(40^\circ+9^\circ)]}\times\sin 9^\circ\times 3{,}800=\frac{1}{\sin 131^\circ}\times .1564\times 3{,}800=1.325\times .1564\times 3{,}800=788$$

pounds compression. The load in the front strut A, is:

$$\frac{1}{\sin[180^\circ-(40^\circ+9^\circ)]}\times\sin 40^\circ\times 3{,}800=1.325\times .6428\times 3{,}800=3{,}240$$

pounds. It will be seen that the addition of these two loads is more than equal to the resultant load of 3,800 pounds, this is because the struts are at an angle to the resultant.

The loads thus found are due to the vertical load only, in addition to this we have a drag component. This drag component is due to the center of gravity being to the rear of the wheels as well as above them. In order that the ship may stay in a level position, the resultant of the vertical and the drag components must pass through the center of gravity.

This resultant is the hypotenuse of a right triangle, the two sides being the vertical distance from the point of intersection of the centerline of the struts on the centerline of the tire to the center of gravity, and the horizontal distance from this point of intersection to the center of gravity. In our ship the vertical distance is 36 inches, as shown on the drawing, and the horizontal distance is 10 inches as shown.

Then: $\sqrt{36^2+10^2}=37.36$ inches which is the length of the resultant. Then the resultant force is $37.36/36\times 1{,}400=1{,}460$ pounds. The drag component is: $10/37.36\times 1{,}460=375$ pounds. This load acts back and at the point of intersection of the centerline of the struts and the centerline of the tire.

Then the load in the front strut is:

$$\frac{1}{\sin 49^\circ}\times\sin 53^\circ\times 375=\frac{1}{.7547}\times .7986\times 375=397$$

pounds tension, it is tension because the action of the drag tends to swing the wheel down as well as back because of the position of the rear strut.

Now the load in the rear strut is:

$$\frac{1}{\sin 49^\circ}\times\sin 78^\circ\times 375=\frac{1}{.7547}\times .9781\times 375=485$$

pounds compression.

We have the two separate loads in the struts caused by the vertical and drag components. Then the final load is the sum of these two loads. As the drag load in the front strut is tension, we subtract it from the load caused by the vertical component, we have: $3{,}240-397=2{,}843$ pounds compression.

As both loads in the rear strut are compression we add them: $788+485=1{,}273$ pounds.

This completes the level landing condition.

END

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3/32x3/32 30, 5c
⅛x⅛ 30 for 5c
⅛x3/16 12 for 5c
⅛x¼ 10 for 5c
3/16x3/16 8, 5c
¼x¼ 6 for 5c
¼x½ 3 for 5c
½x½ 2 for 5c
1/64x2 6 for 10c
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All col., doz. 19c
Silver ....ea. 5c
Superfine, wh. 5c

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Brch	Blsa	Celu
½	.01	.03
¾	.02	.04 .05
1	.03	.05 .07
1⅛	.04	.08 .10
1⅞	.07	.10 .15
3		.15 .30

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¾x1¼x12 3c ea.
1 x1½x12 4c ea.
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TRI-STATE COLLEGE

Naval Planes

(*Continued from page* 16)

huge taper-winged biplane, of much the same general appearance as the small BG-1 but being of a much larger size and using an 830 h.p. *Twin Wasp* R-1830 engine.

Fuselage and tail were of all metal construction and the landing gear was of retractable type, folding into wells in the fuselage sides just aft of the engine. The first ship of this type crashed as Lee Gehlbach, noted test pilot, was putting it through its paces high above Ravenna, O., but later a second ship of the same type was built. It proved to be inferior in general performance to the Douglas entry in this competition however, and so was not purchased. Still another case where the biplane is being pushed out of the picture by the more efficient monoplane.

Martin has produced more torpedo and bombing aircraft than has any other maker. This firm has long been recognized as the chief supplier of "three purpose" Naval aircraft. The first of this type appeared in 1926 when the T3M-1 made its debut. Both this type and the later T3M-2 were used for some time on both wheel and float gear.

Although speeds on these ships were somewhat lower than on earlier "DT" ships, they were much more rugged and dependable than their predecessors. The weight of these ships had steadily been getting heavier; the early DT-2 weighed 7,290 pounds, while the T3M-1 weighed 9,725 pounds.

This latter ship was the last of the water cooled torpedo planes, all subsequent models following the Navy's dictum of using air cooled powerplants exclusively. The T4M-1, a *Hornet*-powered version of the T3M, weighed 2,000 pounds, less than the water-cooled ship and at the same time was five miles per hour faster, and on less horsepower. One hundred and two of these T4M-1's were produced, so popular did these ships prove. In fact it is only in the last year that the T4M's have been retired from service.

Martin's successful dive bomber, the XT5M-1, mentioned earlier in this article, was a joint development of the Naval Aircraft Factory and the Martin company. Although first designated as XT5M-1, or Torpedo Type 5, production models were known as bombers, or BM-1's and BM-2's.

These ships were the first true dive-bombers to be produced with this one purpose in mind. Engines were 600 h.p. P&W *Hornets* and ship structure was wholly of metal; the fuselage being monocoque and the wings having fabric covering.

The last in the Martin torpedo series was the XT6M-1, a rather strange looking long-nosed biplane of all metal construction. A crew of two was carried and provision was made for the carrying of a standard torpedo or its equivalent in small bombs. It proved to be unsuited for service use and was not produced.

The Naval Aircraft Factory in Philadelphia functions mainly as an experimental laboratory for new types of aircraft and components. It has made only two distinct torpedo types; the XTN-1, a twin engined float equipped biplane, and the XT2N-1 two place dive-bomber.

This latter ship was in all respects very similar to the Martin XT5M-1. The XTN-1 was produced finally by the Douglas Company under the name of T2D-1. The original ship used two *Cyclones* of 500 h.p. each. The XT2N-1 had as its power plant a *Cyclone* R-1750-D engine.

The last company represented in the torpedo and bombing series is the Northrop Corporation of Inglewood, Cal. This famous concern has recently been given a contract for 54 of the BT-1 type dive bombers. This all metal ship is a radical departure from previous dive bombers and it will be interesting to know how successful it is in service use.

Although being basically similar to the Army's A-17 attack planes, the BT-1, however, has a semi-retractable landing gear, a wider cowling over its *Twin Wasp Junior* engine and a modified tail structure built to accommodate the necessary carrier arresting gear.

No performance figures have been released as yet, but unless appearances are deceiving it should be rather faster than its Army prototype.

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GIVE 'ER THE GUN

START A POWER DIVE

The Big

SEPTEMBER

issue will . . . start out with a bang-up cover showing the ultra-new Brewster scout-bomber now being secretly tested by the United States Navy. This ship is so new it was like pulling teeth to get enough material to give us an authentic "scoop" full-color cover. Not only that, the September issue of POPULAR AVIATION also will be jam-packed with reams of live eye-opening aviation pictures from many corners of the world. It seems that even P.A. authors were on edge for this big issue too, for there's a choice selection of easy-to-read articles on everything from Aileron to Zipper. The model builder will have an inspiring piece of work to master according to the detailed but easily understandable plans drawn up by Paul Lindberg, POPULAR AVIATION's model editor. The Brewster makes a crackerjack model, too.

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BUFFALO PUBLIC LIBRARY DEPARTMENT OF TECHNOLOGY

Airline Traffic Department

(*Continued from page 38*)

the matter of releasing this seat is only a matter of seconds.

Even a short cut in the use of the telemeter system is used for reservations' communications. Eighteen airline companies are in accord on standard code words and these are also acceptable in the transmission of Western Union and Postal Telegraph messages pertaining to space. The reservations guide lists these codes for quick-reference and have been circulated as far as London and Honolulu.

A sample message, using the code system, relates to a request from the Chicago office via telemeter asking for the release of a Cleveland-Newark seat, so that Mr. Jones can be issued a through Chicago-Newark seat:

NEED JONES ACVNK THUAF THUAF

Chicago states to Cleveland: Need Jones one seat (A) Cleveland (CV) to Newark (NK) Thursday (THU) Trip 16 (AF). By repeating THUAF, Chicago indicates that Mr. Jones will arrive in Cleveland via Trip 16 Thursday.

In confirming this request Cleveland replies: CONOG JONES ACVNK THUAF.

CON means confirming, OG means Seat 7, Jones is the passenger's name. ACVNK means one seat from Cleveland to Newark and THUAF means Thursday on Trip 16.

A new reservations control room has just been installed at the Chicago airport and this will doubtless be adapted for offices elsewhere. It is not unlike King Arthur's round table and 12 men can function at this table at once. Each reservation is made on a card by the clerk and this card goes to the control man who tabulates the reservation on the chart for the trip desired.

Already, this round-table arrangement has proven itself as a time-saver, the most important step in any phase of air transportation. Many other modern appliances are installed in reservations offices. One is the time-minder, a light system which, when set for a certain hour, glows a warning to the reservations department that it is time to make a call or to confirm a reservation.

The reservations department is hand-in-hand with the passenger service department. Each passenger's trip must be enjoyable and convenient. Most of all, the passenger should experience a minimum of detail in making his reservation.

United's reservations department is vital from the standpoint of analyzing traffic problems and situations. Should it appear that a certain trip is going to be sold out with the possibility of more demands for seats, reservations contacts the operations department and arranges for the placing of a second section on this trip.

The reservations department also maintains a running record of passenger loads which are forwarded to field headquarters in Chicago every ten days. Here they are tabulated and distributed to interested departments, such as traffic, who have a picture of passenger traffic thrice monthly, almost as quickly as the period is completed. This information is used to feel the pulse of traffic flow—to determine when and where additional schedules are needed to fill a specific local need. END

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1/16x1/4 15 for 5c
1/16x1/2 5 for 5c
3/32x3/32 30. 5c
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1/8x1/4 10 for 5c
3/16x3/16 8. 5c
1/4x1/4 6 for 5c
1/4x1/2 3 for 5c
1/2x1/2 2 for 5c
1/64x2 6 for 10c
1/32x2 8 for 10c
1/16x2 8 for 10c
3/32x2 7 for 10c
1/8x2 6 for 10c
3/16x2 3 for 9c
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3" sheets or 36" lengths, double above prices; add 10c packing charge for 36" lengths.

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1x2x1 .....1c
2x2x1 .....2c
2x2½x1 .....3c
3x3x1 .....5c
3x3x2 .....8c
3x3x3 .....10c

Alum. Tubing

1/16", 3/16", 1/4" .....10c ft.

Rubber Motors

1/16 sq. 20 ft. 5c
1/8 flat 20 ft. 5c

Sheet Aluminum

.003 ..sq. ft. 10c

TISSUE, AA

All col., 4oz. 19c
Silver .....ea. 5c
Superfine, wh. 5c

WHEELS per pr.

	Brch	Bisa	Celu
½	.01	.03	
¾	.02	.04	.05
1	.03	.05	.07
1¾	.04	.08	.10
1⅞	.07	.10	.16
3		.15	.30

18" Balsa Planks

1x1' ...1 for 4c
1x2 ...1 for 9c
2x2 ...1 for 15c
2x3 ...1 for 22c
2x6 ...1 for 35c

PROPELLER BLOCKS

½x ¾x 5 8—5c
½x ¾x 6 6—5c
⅝x1 x 7 4—5c
⅝x1 x 8 3—5c
¾ x1¼x10 2—5c
¾x1¼x12 3c ea.
1 x1½x12 4c ea.
1 x1½x15 6c ea.

DOPE Clear

1 oz. 5c ½ pt. 25c
2 oz. 10c

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2 oz. 10c

BAMBOO 11 in.

1/16x¼...6 for 5c
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ALUM. LEAF

2 Sheets 1c

WIRE

6 ft. 3c

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Best, 1 oz....5c

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1/32, 1/16" 3 ft. 1c
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10c. Add 5c per in. up to 10 in.

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5 in. 4c
Add 1c per in. up to 16 in.

THRUST BEARINGS 1c
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Doz. 3c

ALUMINUM WHEELS

1" pr.....6c
13.8" pr.....11c
17.8" pr.....14c

NOSE PLUGS

large ...10c doz.
small ...5c doz.

CEMENT

1 oz. 5c
½ pt. 25c

Model Pins

pkg. 5c

Brushes No. 6 5c

INSIGNIAS—
French, American, English, German

1¼" ....4 for 3c
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20x30" ..1 for 9c
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The Airplane and the Law

(*Continued from page 32*)

of passengers by airplane; and it is satisfactory neither to those who have claims against the operators nor to the operators themselves.

The courts hold that it is the duty of the companies to exercise "the highest degree of care" for the safety of their passengers, and the lawyers for the companies contend that that test is too rigid, particularly as applied to a young and growing industry with the tremendous social, economic and military potentialities of aviation. But the law also puts the burden of proving the lack of proper care on the litigant who seeks to hold the carrier liable, and the lawyers for such litigants contend that that is unfair because most accidents of a fatal nature occur in remote places and under such conditions as to make the production of direct evidence impossible.

They argue that the mere occurrence of an accident ought to be *prima facie* evidence of negligence and that it ought to be the duty of the carrier to establish its freedom from fault instead of the duty of the claimant to establish its negligence. They contend further that the law favors the carriers because of two ancient doctrines read into the law by the courts.

One of these doctrines is that a passenger assumes the risks incident to the type of transportation of which he sees fit to avail himself—the perils of the sea, the dangers of the road, or the dangers inherent in "that powerful and dangerous agency, steam."

The other is that a carrier is not responsible for unavoidable accidents nor for accidents due to that mysterious something known as "an act of God." Brought into the law of the air, these doctrines have the effect of making a passenger assume the "risks of the air" and of absolving the carrier from liability for a crash found by the jury to be due to either of the agencies named.

How these rules and doctrines, developed in the "horse and buggy" age, work in actual practice when applied to an age on wings, and whether, in litigation between air transport companies and persons seeking to hold them liable for injuries or wrongful death, they operate to the advantage or the disadvantage of the one or the other, can perhaps be determined best by making a list of the reported cases and noting what was the outcome.

I proceed, therefore, to list, first, the cases in which the companies won and then those in which the companies lost—limiting myself, it must be understood, to cases involving casualties on scheduled airlines operating as common carriers of passengers.

Taken chronologically, the cases won by the companies are the following:—

(1) Allison against the Standard Air Lines, an action brought by the plaintiff as administrator of the estate of Thomas J. Kelly, who was killed March 30, 1929, when the plane on which he was traveling crashed on a mountainside near Banning, California, killing the pilot and his three passengers.

The case came on for trial in the Federal district court in September, 1930, and the company interposed the defense that the accident was due to unexpected fog and was, therefore, unavoidable. The court instructed the jury that it was the duty of the company, as already stated, to "exercise the highest degree of care" for the safety of the passengers but also charged that the defendant was not liable for injuries or death caused by an unavoidable accident.

The jury brought in a verdict for the company, and judgment was entered accordingly. This judgment was later affirmed by the Circuit Court of Appeals.

(2) Thomas against the American Airways, in which the widow of Arthur E. Thomas sought to recover damages for his death in a crash that occurred March 19, 1932, in the same mountain pass as the one involved in the Allison case. Judge James, who presided at the trial in this case, instructed the jury that it was the duty of the defendant to exercise "the highest degree of skill and care commensurate with the practical operation" of its planes and to use "the utmost care and diligence in procuring experienced pilots and in supplying them with information regarding weather conditions."

On the other hand, he specifically told the jury that a passenger assumed the risks "necessarily incident" to flying and that the company was not liable for an accident due to an act of God. The jury found for the defendant.

(*To be continued*)

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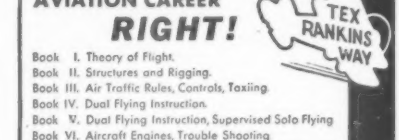

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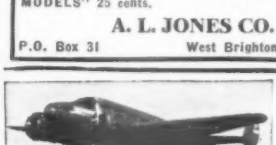

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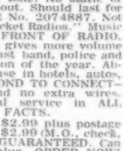

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Doings in the Stratosphere

(*Continued from page 30*)

lized into concentrate form suitable for practical utilization.

Recent development along the pristine "frontier of the sky" accord present altitude honors to Captains Albert W. Stevens and Orvil A. Anderson, whose epochal ascent last Armistice Day added renewed impetus to stratosphere possibilities. In the National Geographic-Army Air Corp's huge balloon, *Explorer II*, these intrepid airmen offset all former official and unofficial marks by touching a new "ceiling" at 72,395 feet.

Specifically, this expedition was organized to seek additional scientific data regarding cosmic rays as well as stratosphere air and ozone. Other important subjects for consideration were embodied in a study of changes in electrical conductivity of the air with increasing altiture, behavior of radio signals sent from the "top of the world" and the effect of stratosphere on living spores.

Observance of sky, sun and earth brightness, wind direction and velocity, and balloon navigation problems were also included in the repertoire of the epic flight. Although science may perhaps claim a predominance of interest in these subjects, nevertheless aviation is influenced, either directly or indirectly, by the greater portion of them.

Difference between the earth's surface and the stratosphere with reference to both air density and atmospheric pressure rendered an artificial supply of oxygen imperative for sustaining life during the flight. The circumstance of thin, upper air, rarified to approximately 1/25th usual density and a greatly reduced atmospheric pressure encountered in extreme altitudes produce a combination assuredly fatal to the unprepared explorer.

An unfortunate human subjected suddenly to the stratosphere air would undoubtedly expand similar to certain species of deep-sea fish that are hauled up from great depths to the much lower pressure at the ocean's surface.

Captains Stevens and Anderson reported a low temperature of 76 degrees below zero in the thin-air envelope of jet black space which clothes our universe much as the outer skin surrounds an orange and rises to extend from seven to 30 miles above sea level.

Stratosphere temperature is practically unvariable due to the fact that the atmospheric absorption is almost exactly balanced by heat radiation. Air, warmed by the sun at the earth's surface rises, with resultant expansion and loss of heat, thus accounting for the low temperature register.

Contrary to layman conjecture, the fliers did not find the sky brighter as they arose nearer the sun; instead the heavens were a deep blue-black, tinged with purple and, paradoxically, greater darkness was recorded on the side of their gondola which faced the sun than on the shadow side.

Beneath them the earth lost much of its detail and the horizon became a blurred unreality. The two men climaxed their memorable flight by a safe landing which left intact and undamaged the veritable cargo of delicate apparatus, registering priceless records for scientific study.

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